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# AN ANALYSIS OF WHOLESALE MILK DELIVERY COSTS AND VOLUME-PRICING PROCEDURES IN CALIFORNIA

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## *SUMMARY*

Minimum wholesale prices for fluid milk in California are established by the Director of Agriculture. The pricing schedules presently established for most marketing areas in the state contain provisions for price discounts as size of delivery order increases. These volume-discount schedules are designed to provide price differences reflecting differential delivery costs associated with varying delivery volumes and are based on analyses of wholesale milk delivery costs conducted by the Giannini Foundation in 1950 and 1959.

Since the 1959 analysis of wholesale milk delivery costs, several changes have occurred which affect time requirements for wholesale milk delivery and thus influence delivery costs. Such changes include use of different types of hauling and unloading equipment and changes in road and traffic conditions as well as differing combinations of delivery services provided by milk distributors. This study was undertaken at the request of the Bureau of Milk Stabilization, California Department of Agriculture, to ascertain the effect of such changes on wholesale milk delivery costs and to evaluate the wholesale volume-discount pricing schedules presently established by the Bureau of Milk Stabilization.

Wholesale routes of milk distributors in the Central Coast Counties Marketing Area and Southern Metropolitan Marketing Area were selected for study. Time requirements for various components of wholesale milk delivery operations were estimated. These time requirements data were then combined with labor-cost and truck-cost estimates to obtain a relationship between unit delivery cost and delivery volume per stop for two different types of delivery service in each marketing area. In all cases, unit delivery cost declines substantially as delivery volume per stop increases.

By adding nondelivery costs to delivery costs, relationships between total unit cost and delivery volume per stop for limited-service and full-service deliveries were obtained. These unit cost functions were compared with the volume-discount pricing schedules presently established by the Bureau of Milk Stabilization in each marketing area to ascertain the extent to which the prices established reflect cost differences associated with varying delivery volumes.

Results of the cost-price comparisons suggest that modifications of the present volume-discount schedules in the two marketing areas are needed if cost differences associated with varying delivery volumes are to be accurately reflected in price differences. Larger discounts are needed for all except the smallest delivery volumes, and additional discount brackets are needed for the largest delivery volumes.

While the present bracket-type, volume-discount schedule could be modified to obtain increased accuracy in reflecting cost differences, the increased accuracy can only be obtained at the expense of computational complexity. An increased number of percentage discounts must be established along with stating the discounts in fractional terms rather than in terms of integers. As an alternative to modifying the present bracket-type discount schedule, a service-charge-type pricing schedule is proposed. This schedule results in price differentials which do accurately reflect delivery cost differences for varying delivery volumes.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# AN ANALYSIS OF WHOLESALE MILK DELIVERY COSTS AND VOLUME-PRICING PROCEDURES IN CALIFORNIA

by

Richard H. Courtney[1] and Elton O. Brooks[2]

## *INTRODUCTION*

Since passage of the Desmond Act in 1937, minimum wholesale and minimum retail prices of fluid milk in California have been established by the Director of Agriculture. Minimum prices received by producers for fluid milk are also established by the Director under authority of the Young Act passed by the California Legislature in 1935.[3] Provisions contained in the Agricultural Code of California set forth the general procedures to be used by the Director in establishing these prices.[4]

For several years following passage of the Desmond Act, minimum wholesale prices were established which were uniform among buyers. No provisions were made for price differentials to reflect cost differences involved in making deliveries of varying sizes. As a result, incentives were provided for milk distributors and wholesale buyers to circumvent the minimum prices established.[5]

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[3] For a discussion of the origins of governmental milk price control in California, see J. M. Tinley, *Public Regulation of Milk Marketing in California* (Berkeley: University of California Press, 1938), Chapters I-IV; and D. A. Clarke, Jr., *Fluid Milk Price Control in California*, Special Report of the Joint Legislative Committee on Agricultural and Livestock Problems (Sacramento: State Printing Office, 1955), Part I.

[4] California, *Agricultural Code of California* (1969), Division 21, Part 3, Chapter 2.

[5] For a discussion of the effects of the uniform pricing procedure, see D. A. Clarke, Jr., *Milk Delivery Costs and Volume Pricing Procedures in California*, California Agricultural Experiment Station Bulletin 757 (Berkeley, 1956), pp. 9-13.

In 1950 the Giannini Foundation was asked to make a study of wholesale milk delivery costs and to suggest alternative pricing schedules which would reflect cost differentials associated with varying delivery volumes. Based on results obtained in the Giannini Foundation's study, minimum wholesale price schedules were developed and implemented which incorporated prices differentials to reflect cost differences associated with varying delivery volumes.[6] In 1959 another study of wholesale milk delivery costs was made and the results used to modify wholesale volume-pricing schedules to reflect changes in delivery operations which occurred between 1950 and 1959.[7] The wholesale volume-pricing schedules presently established by the Bureau of Milk Stabilization–the agency that administers the state's milk price control program–are based on the 1950 and 1959 analyses of wholesale milk delivery operations, adjusted for changes in rates of cost over time.

For purposes of establishing minimum prices for fluid milk, the Agricultural Code specifies that "marketing areas" shall be designated within which "the conditions affecting the production, distribution, and sale of fluid milk, fluid cream, and fluid skim milk are reasonably uniform."[8] The number of marketing areas in the state has varied considerably over time. In 1955 there were 37 marketing areas. By 1960 the number had declined to 28, and at present there are only 14 such areas. Ten of the current marketing areas are further divided into two or more "zones" with differentiated minimum wholesale and minimum retail prices. In total, there are currently 30 different areas in which minimum wholesale and minimum retail prices must be established.

The "bracket" type wholesale volume-pricing schedule presently used in all but three marketing areas in the state is illustrated in Figure 1.[9] The sale of fluid milk items in a single delivery to a wholesale customer is subject to a schedule of percentage discounts based on dollar value of the sale. The percentages increase as dollar value of the sale increases. As illustrated in Figure 1, for a single delivery having a value of less than $V_1$ dollars, no discount is given and the base price for all items is the effective price. For single deliveries having a value between $V_1$ and $V_2$ dollars, a specified percentage discount is given. The effective price for all items is, thus, the base price less the percentage discount. Single deliveries having a value between $V_2$ and $V_3$ dollars qualify for a larger discount. For single deliveries having a dollar value greater than $V_3$ dollars, a still larger discount is allowed.

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[6] *Ibid.*, 77p.

[7] Olan D. Forker and D. A. Clarke, Jr., *Changes in Milk Delivery Costs and Volume-Pricing Procedures in California*, University of California, Giannini Foundation Mimeographed Report No. 236 (Berkeley, 1960), 42p.

[8] California, *op. cit.*, Division 21, Part 3, Chapter 2, Article 10, Section 62081.

[9] A uniform pricing schedule is still employed in the Siskiyou and Inyo-Mono marketing areas. In the San Diego-Imperial marketing area, a "continuous" type volume-pricing schedule is used. For a discussion of this type schedule, see Forker and Clarke, *op. cit.*, pp. 2-4.

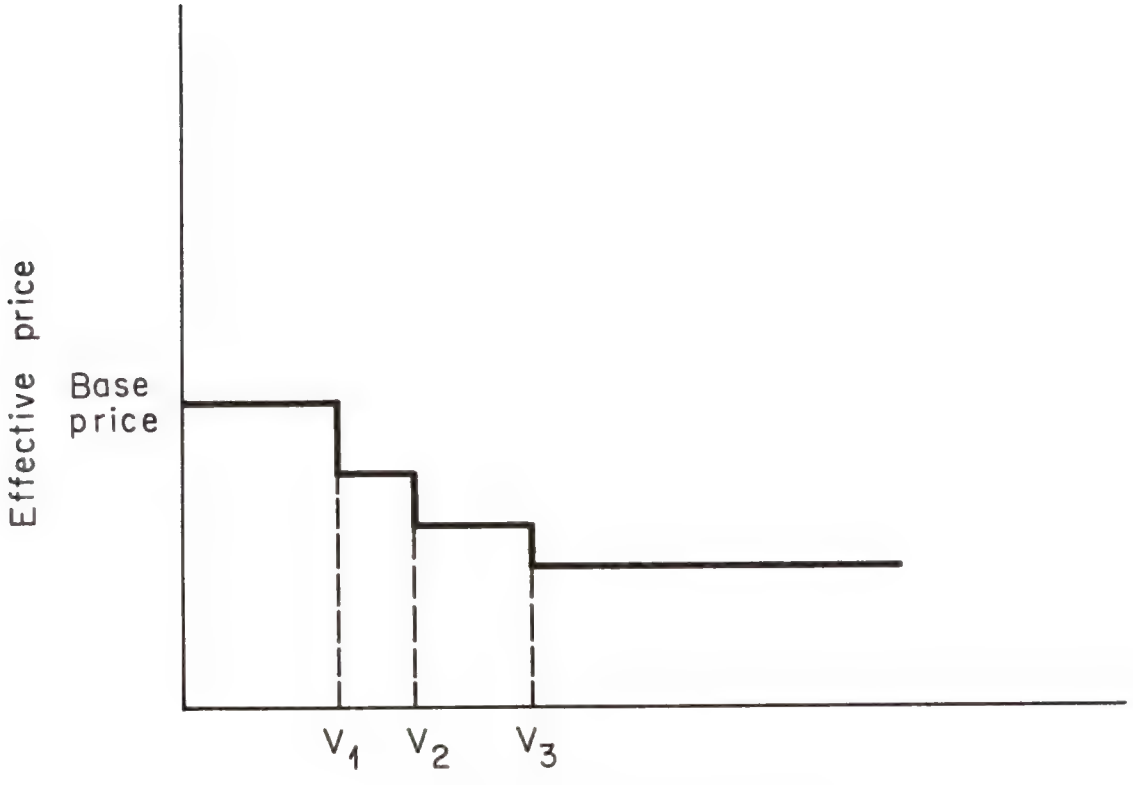


FIGURE 1 Bracket-Type, Volume-Pricing Schedule

At present the Bureau of Milk Stabilization defines two different types of wholesale deliveries which differ in the conditions of sale and amount of services provided by the milk distributor.[10] Different discount schedules apply for each type of delivery service.

Since the 1959 study of wholesale milk delivery operations, several changes have occurred which affect delivery time requirements and thus influence delivery costs. These changes include the use of different types of hauling and unloading equipment as well as changes in road and traffic conditions incurred on wholesale routes. Differing combinations of delivery services currently provided by the milk route driver may also have affected delivery time-volume relationships and delivery costs. Perhaps the most important change has been the continued increase in the number of large retail food stores and the increasing percentage of total milk sales made by these stores. Large-volume milk deliveries are made to such stores–larger than were observed in the two earlier studies. Any errors in establishing volume discounts for such large deliveries, especially if the errors tend to prevent full recognition of any cost savings, could be a factor in stimulating efforts to bypass minimum pricing provisions of the law, just as the uniform pricing procedure fostered such attempts.

Due to the changes noted above and their possible effects on basic input-output relationships in milk delivery, this study was undertaken to estimate wholesale milk delivery costs in California under current conditions. Specific objectives of the study are:

1. To determine effect of delivery volume per customer on unit delivery cost.

2. To determine effect of type of delivery services provided on milk delivery costs.

3. To evaluate the volume-pricing schedules presently established by the Bureau of Milk Stabilization to ascertain if these schedules accurately reflect differences in delivery costs associated with varying delivery volumes.

## *PROCEDURES*

The Central Coast Counties Marketing Area (CCCMA) and Southern Metropolitan Marketing Area (SMMA) were selected for study of wholesale milk delivery operations.[11] In each marketing area, milk distributors were selected whose routes would be studied.

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[10] Conditions associated with each type of delivery service are contained in the schedule of minimum wholesale and minimum retail prices issued by the Director, California Department of Agriculture for each marketing area.

[11] The Central Coast Counties Marketing Area includes all of Alameda, Contra Costa, Monterey, San Benito, San Francisco, San Mateo, Santa Clara, and Santa Cruz counties. The Southern Metropolitan Marketing Area includes all of Los Angeles, Orange, San Bernardino, and Riverside counties as well as portions of Ventura and Santa Barbara counties.

Personnel from the Bureau of Milk Stabilization assisted in this selection process based on their knowledge of individual firm operations. Firms were selected whose combined sales represented a substantial proportion of fluid milk sales in each marketing area but which also represented a cross section of distributor types.

Routes of 11 distributors were observed in each marketing area. Seven of these firms were included in both marketing areas. In the SMMA, six of the distributors were classified as "conventional" in that the distributor is a separate legal entity from the customers served. In the CCCMA, five of the firms were classified as conventional distributors. Four firms in the SMMA and three firms in the CCCMA were classified as "integrated" distributors since these firms only serve customers in which ownership is in common with that of the milk distributor. The remaining one firm in the SMMA and three firms in the CCCMA were classified as "semi-integrated" distributors. These distributors have some characteristics of the integrated distributors in that they serve some customers having ownership in common with that of the distributor, but they also serve some customers on the same basis as conventional distributors.

Next, routes from each distributor were selected for observation. This was done with assistance of route supervisors from each firm. As in the previous two studies, an attempt was made to select routes which included a substantial number of large-volume deliveries per customer. Thus, the sample of routes selected is disproportionately weighted toward routes serving large-volume customers and is not expected to be representative in that the number of customer delivery observations by volume and type of customer included in the sample is not proportional to the numbers in the population sampled.

Although the volume of milk delivered per stop has been increasing over time due to the increasing importance of large-volume retail stores as an outlet for fluid milk, relatively small volumes per delivery still characterize the majority of the number of wholesale milk deliveries. If a proportional sample were used, the small number of observations in the large-volume delivery categories would result in less reliability than would a sample disproportionately weighted by large-volume observations. This was the basis for selecting routes having substantial numbers of large-volume deliveries.

A total of 108 wholesale milk routes were observed--46 in the CCCMA during November and December, 1970, and 62 routes in the SMMA during February and March, 1971. Each route was observed for one day by a Bureau of Milk Stabilization employee.

Observations were made of 962 individual customer deliveries--422 in CCCMA and 540 in SMMA. For each customer stop, all delivery operations performed by the driver were recorded along with time expended. In addition, information was obtained on the time spent by the driver at the plant before and after the route, miscellaneous time spent by the driver while on the route (waiting, personal time, and so on), number of miles driven from the plant to first customer stop on the route, miles driven between the first and last customer stops, and mileage from last customer stop to the plant along with the time required for each of these driving segments.[12]

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[12] See Appendix A for the instructions provided each observer and the forms to be completed for each route and each stop.

At each stop, the quantity of products delivered was also noted. Since a number of different products as well as container sizes are handled on wholesale milk routes, some method was needed by which the different products and container sizes could be aggregated into a single measure of volume. For a number of years, the Bureau of Milk Stabilization has utilized a system of weights known as "labor units" for aggregating the various products and container sizes handled on wholesale routes. Each labor unit is theoretically equivalent--in terms of its labor requirement in wholesale delivery--to a single quart of milk. For purposes of this study, the modifiers developed by the Bureau were accepted as a means of aggregating products and container sizes, and delivery volumes were measured in terms of labor units.[13]

Using the information obtained from the detailed study of wholesale milk delivery routes, time requirements for various components of wholesale milk delivery are estimated. Then labor costs and truck costs are estimated and combined with the time requirements data to estimate cost-volume relationships in wholesale milk delivery. Finally, these results are used to evaluate volume discount schedules presently established by the Bureau of Milk Stabilization.

## *TIME REQUIREMENTS*

Total time expended by the driver on wholesale milk routes is a summation of driving time, delivery time, and miscellaneous time. Time requirements for each of these components are analyzed separately and results presented in the following sections.

### *Driving Time*

The amount of time spent driving the delivery truck on wholesale milk routes is a function of distance traveled and driving speed. For purposes of this study, a relationship between driving time and distance traveled on the route is needed. Driving speed is influenced by a number of factors including road and traffic conditions. Since such factors are difficult to determine objectively, their influence was not explicitly measured in this study. Rather, the results obtained for driving time expressed as a function of distance traveled can be interpreted as reflecting average road and traffic conditions on the routes observed.

It was expected that driving speed would be influenced by differences in driving conditions encountered in driving (1) from the plant to the first customer stop, (2) between customer stops on the route, and (3) from the last customer stop to the plant. For this reason, data were obtained on distance traveled and driving time expended in each driving segment on all routes observed. Single-equation least-squares regression analysis was used to estimate a relationship between driving time and distance traveled in each driving segment. The number of customer stops made on each route was also observed, and this effect on driving time between customer stops was also estimated.

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[13] See "Wholesale Time Study Sheet--Units Delivered" in Appendix A for the labor unit modifiers of various items handled on wholesale routes.

Two basic types of delivery equipment were utilized on wholesale routes observed in this study. The first type was a single-unit or "bobtail" truck with body lengths ranging from 14 to 29 feet. The second type consisted of a tractor and trailer unit with trailer lengths ranging from 24 to 40 feet. In the SMMA, single-unit trucks were used on 29 routes and tractor-trailer units used on the remaining 33 routes. In the CCCMA, each type of delivery unit was used on 23 routes.

Since two types of delivery units were used, it was necessary to determine if the driving time-distance relationship in each driving segment was equal for both types of units or that observed differences in the relationships estimated were consistent with differences that might reasonably be expected from different samples drawn from the same population. In both marketing areas and in each driving segment, the hypothesis that the driving time-distance relationships were equal for both types of delivery units was rejected, making it necessary to consider each type of delivery unit separately.[14]

The hypothesis of equality in driving time-distance relationships for a single type of delivery truck in both marketing areas was also tested. This hypothesis could not be rejected at the 5 percent level of significance for either type of delivery unit. Consequently, a single driving time-distance relationship was used in both marketing areas for each type of delivery unit.

The estimated relationships between distance and driving time for single-unit trucks are presented in Table 1. Similar results for tractor-trailer units are presented in Table 2.

Two major differences should be noted in results obtained for the two types of delivery units. First, average route distance differed considerably for the two types of units. Routes on which single-unit trucks were used averaged 51.0 miles, while routes on which tractor-trailer units were used averaged 78.4 miles. Second, the amount of driving time associated with each customer stop is estimated to be much greater for tractor-trailer units than for single-unit trucks. This result is probably due to differences in unloading methods used for the different units. The majority of stops at which tractor-trailer units were used provided unloading docks. Additional time is required for maneuvering the tractor-trailer units to the dock for unloading and away from the dock after unloading compared to the time required for parking single-unit trucks which do not utilize unloading docks.

Using results presented in Tables 1 and 2, a single equation was obtained for each type of delivery unit expressing total route driving time as a function of distance traveled and number of customer stops on the route. These equations are as follows:

$$DT = 29.54 + 1.20M + 2.15\ (C - 1) \text{ for single-unit trucks} \qquad (1)$$

and

$$DT = 23.87 + 1.26M + 9.42\ (C - 1) \text{ for tractor-trailer units} \qquad (2)$$

[14] The F-statistic was used for making the test of similarity in driving time-distance relationships for the two types of delivery units. The hypothesis tested was rejected at the 1 percent level of significance. Throughout this report, the F-statistic is used for testing similarity between various estimated relationships.

TABLE 1

Effect of Distance Traveled and Number of Customer Stops on Driving Time for Single-Unit Trucks on Wholesale Milk Delivery Routes, Central Coast Counties and Southern Metropolitan Marketing Areas Combined, 1970-71

| Driving segment | Total distance | | Fixed time per day | Time per mile | Time per customer[a/] | Coefficient of determination |
|---|---|---|---|---|---|---|
| | miles | percentage | minutes | | | |
| Plant to first stop | 13.8 | 27.07 | 6.32 | 1.15 | | 0.85 |
| First stop to last stop | 21.1 | 41.34 | 13.83 | 1.37 | 2.15 | 0.83 |
| Last stop to plant | 16.1 | 31.59 | 9.39 | 1.01 | | 0.71 |
| Total | 51.0 | 100.00 | 29.54 | 1.20[b/] | 2.15 | |

a/ Effect of the number of customer stops on total driving time. This provides for the time required to arrive at each stop (exiting from flow of traffic and parking upon arrival) and depart from each stop (terminating parking and entering flow of traffic). Since driving time spent in arriving at the first customer stop and departing from the last customer stop is attributed to the plant-to-first-stop and last-stop-to-plant driving segment, respectively, the estimated coefficient pertains to one less than the actual number of customer stops on the route.

b/ Summation over all driving segments of time per mile in each driving segment weighted by the proportion of average route distance traveled in that driving segment.

TABLE 2

Effect of Distance Traveled and Number of Customer Stops on Driving Time for Tractor-Trailer Delivery Units on Wholesale Milk Delivery Routes, Central Coast Counties and Southern Metropolitan Marketing Areas Combined, 1970-71

| Driving segment | Total distance | | Fixed time per day | Time per mile | Time per customer[a/] | Coefficient of determination |
|---|---|---|---|---|---|---|
| | miles | percentage | minutes | | | |
| Plant to first stop | 20.7 | 26.42 | 12.26 | 1.19 | | 0.82 |
| First stop to last stop | 29.9 | 38.09 | [b/] | 1.33 | 9.42 | 0.89 |
| Last stop to plant | 27.8 | 35.49 | 11.61 | 1.22 | | 0.77 |
| Total | 78.4 | 100.00 | 23.87 | 1.26[c/] | 9.42 | |

a/ Effect of the number of customer stops on total driving time. This provides for the time required to arrive at each stop (exiting from flow of traffic and parking upon arrival) and depart from each stop (terminating parking and entering flow of traffic). Since driving time spent in arriving at the first customer stop and departing from the last customer stop is attributed to the plant-to-first-stop and last-stop-to-plant driving segment, respectively, the estimated coefficient pertains to one less than the actual number of customer stops on the route.

b/ Coefficient not statistically significant.

c/ Summation over all driving segments of time per mile in each driving segment weighted by the proportion of average route distance traveled in that driving segment.

where

DT = driving time per route day (minutes)

M = distance traveled per route day (miles)

and

C = number of customer stops per route day.

*Direct Delivery Time*

While the number and type of delivery functions performed by the route driver at a customer's location vary among customers, some or all of the following functions are usually performed at each stop: (1) Put up order, (2) transport order, (3) order checked by customer, (4) obtain cash or signature, (5) complete delivery, (6) secure order, (7) service dispensing box, (8) service storage box, and (9) service dispensing box from storage box.[15]

Functions (1) through (5) were termed "basic delivery functions." Performance of these functions, either with or without other functions also being performed, occurred in over 95 percent of all stops observed. Deliveries in which only the basic delivery functions were performed were denoted as "B." Observations in which additional functions were also performed, such as servicing the dispensing box (7) and servicing the storage box (8), were denoted as B + 7 + 8. At each customer stop observed, those delivery functions performed by the driver were recorded.

Timing of direct delivery operations began when the delivery unit was stopped at a customer's premises and ended when the route driver reentered the truck cab and started the delivery unit to continue his route. At each stop, the time required for the driver to perform the basic delivery functions was recorded. In addition, the time required for the driver to perform any of the other delivery functions was also recorded.

Each customer stop was categorized by type of outlet, that is, whether the stop was a grocery, restaurant, bakery, hospital, school, etc. Three categories for type of outlet were established as follows: (1) groceries, markets, and supermarkets; (2) bakeries, cafes, restaurants, liquor stores, etc.; and (3) hospitals and schools. Table 3 shows the number of stops and total delivery volume, by type of stop, for each marketing area.

In both marketing areas, delivery volume to groceries, markets, and supermarkets represented over 90 percent of the total delivery volume on the routes observed. In terms of numbers of stops, however, groceries, markets, and supermarkets represented only

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[15] For a description of delivery functions, see "Wholesale Milk Route Riding Instructions" in Appendix A.

TABLE 3

Delivery Volume and Number of Customers by Type of Stop, Wholesale Milk Delivery Routes
Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

| Type of stop | Marketing area | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Central Coast Counties | | | | Southern Metropolitan | | | |
| | Labor units | | Customer stops | | Labor units | | Customer stops | |
| | number | per-centage | number | per-centage | number | per-centage | number | per-centage |
| Groceries, markets, and supermarkets | 408,237 | 94.91 | 275 | 65.17 | 607,275 | 92.22 | 299 | 55.37 |
| Bakeries, cafes, restaurants, liquor stores, etc. | 12,655 | 2.94 | 105 | 24.88 | 42,229 | 6.41 | 207 | 38.33 |
| Hospitals and schools | 9,222 | 2.14 | 42 | 9.95 | 9,033 | 1.37 | 34 | 6.30 |
| Total | 430,114 | 100.00[a/] | 422 | 100.00 | 658,537 | 100.00 | 540 | 100.00 |

a/ Total rounded.

55.37 percent in SMMA and 65.17 percent in CCCMA. Thus, groceries, markets, and supermarkets are much more important in each marketing area in terms of delivery volume than they are in terms of number of stops. For the other two types of stop categories, the opposite relationship is true. That is, stops in the other two categories are more important in terms of number of stops than they are in terms of delivery volumes. Since the data reported are for a sample of wholesale routes, which is not expected to be representative of the total number of routes in each marketing area, no comparisons across categories of type of stops (either for delivery volumes or number of customers) can be made. That is, it is not valid to conclude that 94.91 percent of the total wholesale delivery volume in CCCMA is made to groceries, markets, and supermarkets. Such comparisons are not valid because an attempt was made to select routes for study which made a substantial number of high-volume stops. Since the groceries, markets, and supermarkets category of type of stop can be expected to contain a large number of high-volume stops, this category is probably overrepresented in the sample while the other categories are underrepresented.

The frequencies at which the various combinations of delivery functions were observed at stops in each category are presented in Table 4 and indicate the large variation among stops in combinations of services provided. The groceries, markets, and supermarkets category in the CCCMA exhibited the greatest variation in types of functions performed, with stops involving only basic delivery functions comprising the largest single component of this category. Stops involving B + 6 + 7 delivery functions represented the second largest single component. Stops at which B + 6 + 7 delivery functions were performed also represented the largest single component of the bakeries, cafes, etc., category in the CCCMA. Stops at which only the basic delivery functions were performed represented the largest single component for hospitals and schools in the CCCMA as well as for the groceries, markets, and supermarkets and bakeries, cafes, etc., categories in the SMMA. Stops at which B + 8 functions were performed represented the largest single component of the hospitals and schools category in the SMMA.

Table 5 shows the cumulative frequency of number of customer stops and delivery volume by type of outlet and delivery volume per stop for each marketing area. As expected, deliveries to bakeries, cafes, etc., and hospitals and schools are concentrated in the lower delivery volume per stop categories, while deliveries to groceries, markets, and supermarkets extend into the larger delivery volume per stop categories. For example, in the CCCMA all deliveries to customers in the bakeries, cafes, etc., and hospitals and schools categories were less than 1,499 labor units per stop. For groceries, markets, and supermarkets, deliveries of 1,499 labor units or less per stop represented only 13.23 percent of the observed total deliveries to groceries, markets, and supermarkets. Again, it should be noted that the results presented pertain to the sample of routes observed which is not expected to be representative of the entire marketing area. To the extent that efforts to observe routes having large-volume-per-stop deliveries were successful, the results obtained will overstate percentages in the larger volume per stop categories and understate percentages in the smaller volume per stop categories. Still, the results do provide a useful description of the distribution of observations obtained and analyzed in this study.

TABLE 4

Combinations of Delivery Functions Provided at Customer Stops by Type of Stop, Wholesale Milk Delivery Routes
Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

| Delivery functions performed[a/] | Marketing area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Central Coast Counties | | | | | | Southern Metropolitan | | | | | |
| | Type of stop | | | | | | | | | | | |
| | Groceries, markets, and supermarkets | | Bakeries, cafes, restaurants, liquor stores, etc. | | Hospitals and schools | | Groceries, markets, and supermarkets | | Bakeries, cafes, restaurants, liquor stores, etc. | | Hospitals and schools | |
| | number | percentage | number | percentage | number | percentage | number | percentage | number | percentage | number | percentage |
| None | 2 | .73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 4 | 1.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.94 |
| 6 | 14 | 5.09 | 6 | 5.71 | 0 | 0 | 1 | .33 | 1 | .48 | 0 | 0 |
| 5 + 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | .67 | 1 | .48 | 0 | 0 |
| 6 + 7 | 4 | 1.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 + 9 | 4 | 1.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 + 7 + 9 | 2 | .73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 + 5 + 6 + 7 + 8 + 9 | 1 | .36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B | 75 | 27.27 | 9 | 8.57 | 22 | 52.38 | 141 | 47.16 | 72 | 34.78 | 11 | 32.35 |
| B + 6 | 4 | 1.45 | 8 | 7.62 | 4 | 9.52 | 99 | 33.11 | 48 | 23.19 | 0 | 0 |
| B + 7 | 0 | 0 | 2 | 1.90 | 8 | 19.05 | 4 | 1.34 | 7 | 3.38 | 1 | 2.94 |
| B + 8 | 5 | 1.82 | 0 | 0 | 0 | 0 | 2 | .67 | 8 | 3.86 | 14 | 41.18 |
| B + 6 + 7 | 51 | 18.55 | 64 | 60.95 | 6 | 14.29 | 36 | 12.04 | 46 | 22.22 | 4 | 11.76 |
| B + 6 + 8 | 5 | 1.82 | 9 | 8.57 | 0 | 0 | 1 | .33 | 16 | 7.73 | 2 | 5.88 |
| B + 6 + 9 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | .33 | 0 | 0 | 0 | 0 |
| B + 6 + 7 + 8 | 24 | 8.73 | 2 | 1.90 | 1 | 2.38 | 4 | 1.34 | 5 | 2.42 | 0 | 0 |
| B + 6 + 7 + 9 | 5 | 1.82 | 1 | .95 | 1 | 2.38 | 2 | .67 | 1 | .48 | 0 | 0 |
| B + 6 + 8 + 9 | 2 | .73 | 0 | 0 | 0 | 0 | 1 | .33 | 0 | 0 | 0 | 0 |
| B + 6 + 7 + 8 + 9 | 40 | 14.55 | 3 | 2.86 | 0 | 0 | 1 | .33 | 2 | .97 | 0 | 0 |
| B + 7 + 8 | 7 | 2.55 | 1 | .95 | 0 | 0 | 4 | 1.34 | 0 | 0 | 1 | 2.94 |
| B + 7 + 9 | 7 | 2.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B + 7 + 8 + 9 | 15 | 5.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B + 8 + 9 | 4 | 1.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 275 | 100.00 | 105 | 100.00[b/] | 42 | 100.00 | 299 | 100.00[b/] | 207 | 100.00[b/] | 34 | 100.00[b/] |

a/ Delivery functions are defined as (1) put up order, (2) transport order, (3) order checked by customer, (4) obtain cash or signature, (5) complete delivery, (6) secure order, (7) service dispensing box, (8) service storage box, and (9) service dispensing box from storage box. Functions (1) through (5) are termed "basic delivery functions" and denoted as "B."

b/ Totals rounded.

TABLE 5

Cumulative Frequency Distribution of Number of Customers and Volume Delivered by Volume Per Stop and Type of Stop, Wholesale Milk Delivery Routes Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

| Volume per stop | Marketing area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Central Coast Counties | | | | | | Southern Metropolitan | | | | | |
| | Type of stop | | | | | | | | | | | |
| | Groceries, markets, and supermarkets | | Bakeries, cafes, restaurants, liquor stores, etc. | | Hospitals and schools | | Groceries, markets, and supermarkets | | Bakeries, cafes, restaurants, liquor stores, etc. | | Hospitals and schools | |
| | Cumulative percentage | | | | | | | | | | | |
| labor units | number of customers | volume delivered | number of customers | volume delivered | number of customers | volume delivered | number of customers | volume delivered | number of customers | volume delivered | number of customers | volume delivered |
| 0- 14 | 12.00 | 0.00 | 14.29 | 0.58 | 7.14 | 0.17 | 2.34 | 0.00 | 12.08 | 0.35 | 11.76 | 0.19 |
| 15- 24 | 13.09 | 0.02 | 25.71 | 2.47 | 9.52 | 0.38 | 2.34 | 0.00 | 15.94 | 0.75 | 14.71 | 0.43 |
| 25- 49 | 18.55 | 0.15 | 45.71 | 8.03 | 16.67 | 1.57 | 6.35 | 0.08 | 28.50 | 3.01 | 20.59 | 1.36 |
| 50- 74 | 21.82 | 0.28 | 55.24 | 12.63 | 26.19 | 4.06 | 10.03 | 0.19 | 40.10 | 6.55 | 32.35 | 4.06 |
| 75- 99 | 25.45 | 0.48 | 64.76 | 19.42 | 28.57 | 4.97 | 12.04 | 0.28 | 53.62 | 12.38 | 35.29 | 4.95 |
| 100- 199 | 31.64 | 1.12 | 87.62 | 44.17 | 47.62 | 18.02 | 20.40 | 0.87 | 69.57 | 24.09 | 64.71 | 20.77 |
| 200- 299 | 35.64 | 1.75 | 90.48 | 50.37 | 78.57 | 51.70 | 24.41 | 1.35 | 78.74 | 35.27 | 79.41 | 34.73 |
| 300- 399 | 37.09 | 2.09 | 92.38 | 56.05 | 88.10 | 66.10 | 29.77 | 2.23 | 87.92 | 50.94 | 82.35 | 39.08 |
| 400- 499 | 41.09 | 3.32 | 95.24 | 66.79 | 92.86 | 75.69 | 31.44 | 2.61 | 91.79 | 59.21 | 82.35 | 39.08 |
| 500- 999 | 47.64 | 6.60 | 99.05 | 90.31 | 97.62 | 87.52 | 39.13 | 5.40 | 98.07 | 77.25 | 85.29 | 45.11 |
| 1,000- 1,499 | 55.27 | 13.23 | 100.00 | 100.00 | 100.00 | 100.00 | 43.48 | 8.03 | 98.07 | 77.25 | 100.00 | 100.00 |
| 1,500- 1,999 | 68.00 | 28.34 | | | | | 52.51 | 16.08 | 99.03 | 85.48 | | |
| 2,000- 2,499 | 76.36 | 41.00 | | | | | 65.22 | 30.28 | 99.52 | 91.28 | | |
| 2,500- 2,999 | 86.18 | 58.97 | | | | | 72.91 | 40.54 | 99.52 | 91.28 | | |
| 3,000- 3,499 | 90.55 | 68.50 | | | | | 79.26 | 50.81 | 99.52 | 91.28 | | |
| 3,500- 3,999 | 92.73 | 74.00 | | | | | 86.29 | 63.77 | 100.00 | 100.00 | | |
| 4,000- 4,499 | 94.18 | 78.05 | | | | | 91.30 | 74.17 | | | | |
| 4,500- 4,999 | 95.64 | 82.77 | | | | | 93.65 | 79.69 | | | | |
| 5,000- 5,499 | 97.09 | 87.76 | | | | | 95.65 | 84.84 | | | | |
| 5,500- 5,999 | 98.91 | 94.89 | | | | | 95.99 | 85.74 | | | | |
| 6,000- 6,999 | 99.64 | 98.04 | | | | | 97.66 | 90.79 | | | | |
| 7,000- 7,999 | 100.00 | 100.00 | | | | | 99.33 | 96.94 | | | | |
| 8,000- 8,999 | | | | | | | 99.67 | 98.29 | | | | |
| 9,000- 9,999 | | | | | | | 99.67 | 98.29 | | | | |
| 10,000-10,999 | | | | | | | 100.00 | 100.00 | | | | |

The amount of time required for the driver to deliver an order at each customer location depends on several factors including quantity of products delivered, physical arrangement of the customer's facilities, and type of unloading equipment used as well as number and type of delivery functions performed. In this analysis quantity of products delivered (measured in terms of labor units) was used as a single variable to explain variation in direct delivery time. Physical arrangement of receiving and storage facilities varies widely by customer. Similarly, type of unloading equipment used varies by distributor and among routes for a single distributor. Since the effect of such variations is difficult to determine objectively, their influence was not explicitly measured. Rather, results obtained are interpreted as reflecting the average of conditions incurred in delivery operations.

Single-equation least-squares regression analysis was used to estimate a relationship between delivery volume per stop (in labor units) and direct delivery time for two different combinations of delivery functions. Direct delivery time for performing the basic delivery functions was first estimated as a function of volume per delivery. Performance of only the basic delivery functions at a stop means that the order size and composition are known by the driver in advance of the stop and no "secure order" function is necessary. Similarly, the driver does not provide any dispensing box or storage box services. The route driver merely delivers the order to a designated point on the customer's premises. This point may be the loading dock, cold storage room, or some other point. A delivery in which only the basic delivery functions are performed is defined as a "limited service" delivery.

The analysis was conducted for both the CCCMA and the SMMA using data for all stops in each marketing area for which the basic delivery functions were performed. At each such stop, other delivery functions may or may not have been performed. The hypothesis that the delivery time-volume relationships in CCCMA and SMMA were equal was tested and rejected at the 1 percent level of significance, meaning that two different relationships must be derived, one for each marketing area. These estimated equations were obtained as:

*Central Coast Counties Marketing Area*

$$BDT = 4.7411 + 0.02967\ V_s \qquad \text{for } V_s \leqslant 1{,}380 \tag{3}$$

$$BDT = 42.0261 + 0.002657\ V_s \qquad \text{for } V_s > 1{,}380 \tag{4}$$

*Southern Metropolitan Marketing Area*

$$BDT = 6.1770 + 0.02602\ V_s \qquad \text{for } V_s \leqslant 787 \tag{5}$$

$$BDT = 23.4887 + 0.004022\ V_s \qquad \text{for } V_s > 787 \tag{6}$$

where BDT is basic delivery time--time required to perform the basic delivery functions (minutes)--and $V_s$ is number of labor units delivered per stop.[16] Each of the estimated coefficients is statistically significant at the 1 percent level.

In the CCCMA, 70.8 percent of the variation in basic delivery time is associated with variation in the number of labor units delivered per stop. Basic delivery time is estimated to increase with delivery volume at a rate of 0.02967 minutes per labor unit for deliveries of less than 1,380 labor units. For delivery volumes of greater than 1,380 labor units, basic delivery time is estimated to increase with delivery volume at a rate of 0.002657 minutes per labor unit. In the SMMA, 61.3 percent of variation in basic delivery time is associated with variation in delivery volume. For delivery volumes of less than 787 labor units, basic delivery time increases at the rate of 0.02602 minutes per labor unit, while for delivery volumes of greater than 787 labor units, basic delivery time increases at the rate of 0.004022 minutes per labor unit.

In the previous analysis, basic delivery time was estimated as a function of delivery volume per stop for all stops in which the basic delivery functions were performed. Further analysis of the data indicated that, in each marketing area, the basic delivery time-volume relationship for deliveries to schools differed from the time-volume relationship estimated for the aggregate of all stops excluding schools.[17] For this reason, a separate basic delivery time-volume relationship for school deliveries in each marketing area was estimated. The hypothesis of equality in the basic delivery time-volume relationships for school deliveries in both marketing areas was tested and could not be rejected at the 5 percent level of significance. Consequently, a single basic delivery time-volume relationship was estimated for both marketing areas as follows:

$$BDT = 3.4557 + 0.01615\ V_s \qquad (7)$$

$$r^2 = 0.484$$

where BDT and $V_s$ are as previously defined. Both coefficients are statistically significant at the 1 percent level. The $r^2$ value of 0.484 indicates that 48.4 percent of the variation in BDT is associated with variation in $V_s$.

For each marketing area, relationships between basic delivery time and delivery volume for the aggregate of all stops, excluding schools, at which the basic delivery functions were performed were estimated as:

---

[16] Several alternative functional forms of the relationship between BDT and $V_s$ were tried, but the linear equations reported provided the best fit to the data.

[17] This result is consistent with results reported by Clarke, *Milk Delivery Costs . . .*, pp. 29 and 30.

*Central Coast Counties Marketing Area*

$$BDT = 5.4875 + 0.02946\ V_s \quad \text{for } V_s \leqslant 1{,}363 \tag{8}$$

$$BDT = 42.0244 + 0.002657\ V_s \quad \text{for } V_s > 1{,}363 \tag{9}$$

*Southern Metropolitan Marketing Area*

$$BDT = 6.1808 + 0.02768\ V_s \quad \text{for } V_s \leqslant 733 \tag{10}$$

$$BDT = 23.5425 + 0.004009\ V_s \quad \text{for } V_s > 733. \tag{11}$$

For the CCCMA, 69.4 percent of the variation in basic delivery time was associated with variation in delivery volume per stop, while in the SMMA the percentage was 61.1. All coefficients are statistically significant at the 1 percent level.

The equations describing the basic delivery time-volume relationships in each marketing area are depicted graphically in Figure 2. The "kink" in the time-volume relationship for each marketing area reflects differences in work methods and unloading equipment used for small-volume versus large-volume deliveries. That is, for small-volume deliveries the route driver uses no equipment or only a hand truck. For larger deliveries, a four-wheel dolly, a battery-powered cart, or a forklift truck is used. The use of different equipment and work methods for different delivery sizes represents changes in the input-output relationships for milk delivery and results in the kinked time-volume relationships. As previously noted, curvilinear and other functional forms were fitted to the basic delivery time-volume data, but the linear equations reported and depicted in Figure 2 provided the best fit of the data.

The previous analyses of delivery time-volume relationships have pertained only to the performance of basic delivery functions at each stop. At many stops the driver performs additional functions. Frequently, a customer's order is not known by the driver in advance of a stop, and it is necessary for him to perform the secure-order function. In addition, he may service the dispensing box and/or the storage box. To estimate a delivery time-volume relationship for deliveries in which the additional functions were performed, a "full service" delivery operation was defined. This operation was defined as a delivery in which all of the basic delivery functions are performed and, in addition, the driver also performs the secure-order, service dispensing box, and service storage box functions.

Single-equation least-squares regression analysis was again used to estimate a relationship between delivery volume per stop (in labor units) and direct delivery time for performing the functions comprising a full-service delivery. Observations were used for all types of stops observed at which the specified functions were performed.

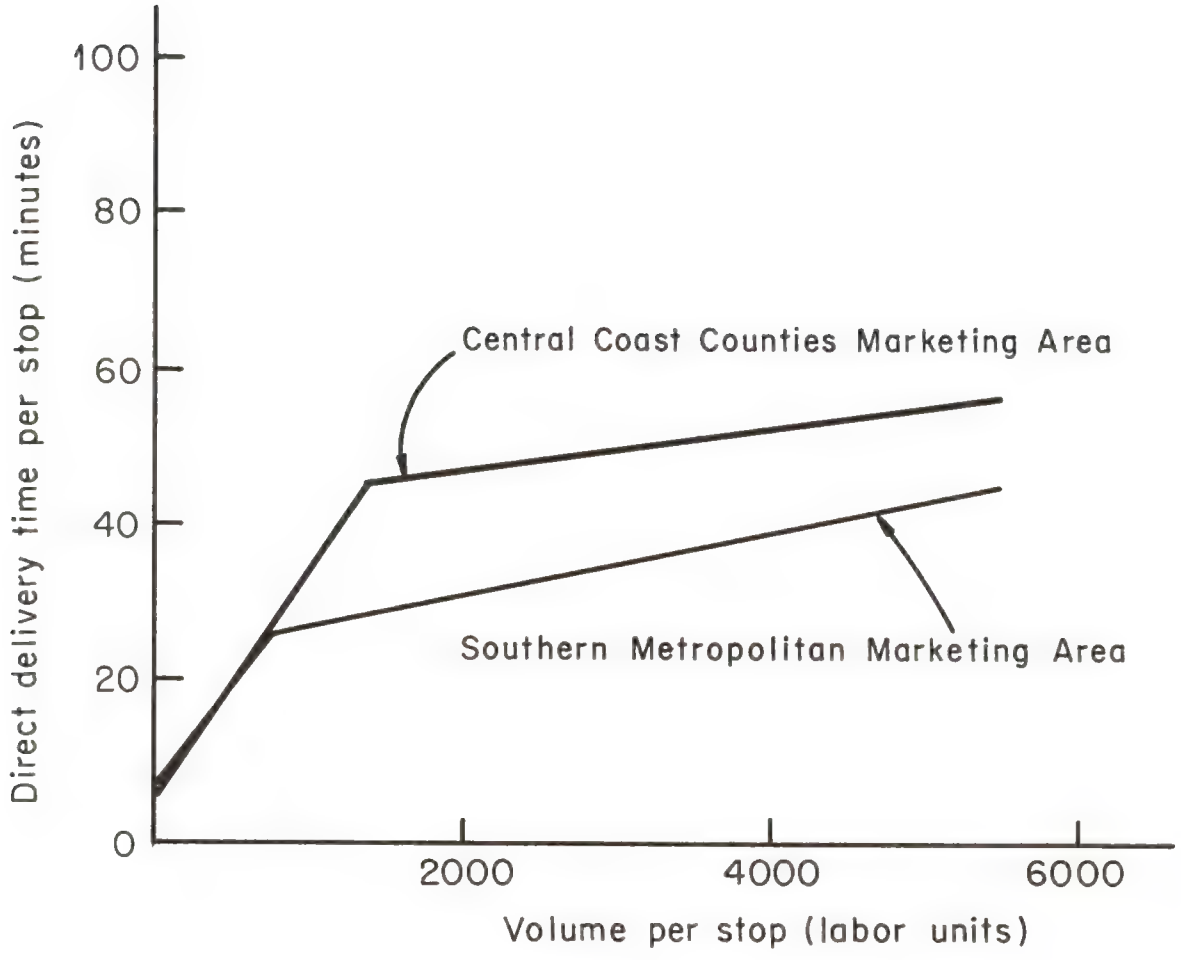


FIGURE 2 Effect of Delivery Volume Per Stop on Time Required for Performing Limited-Service Delivery Functions, Wholesale Milk Delivery Routes, Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

Observations of stops at which the specified functions were not performed were eliminated from this portion of the analysis. The analysis was conducted for each marketing area and for the two marketing areas combined. The hypothesis that the estimated relationships were equal in both marketing areas was rejected at the 1 percent level of significance. Consequently, the direct delivery time-volume relationships estimated for each marketing area individually are used. These estimated relationships are as follows:

*Central Coast Counties Marketing Area*

$$TDT = 11.3745 + 0.04740\ V_s \qquad \text{for } V_s \leqslant 1{,}545 \tag{12}$$

$$TDT = 64.8864 + 0.01276\ V_s \qquad \text{for } V_s > 1{,}545 \tag{13}$$

*Southern Metropolitan Marketing Area*

$$TDT = 11.0753 + 0.05898\ V_s \qquad \text{for } V_s \leqslant 411 \tag{14}$$

$$TDT = 29.6900 + 0.01366\ V_s \qquad \text{for } V_s > 411 \tag{15}$$

where TDT is total delivery time--time required to perform all functions as defined for a full-service delivery--and $V_s$ is number of labor units delivered per stop. The equations are interpreted in the same way as the preceding results for basic delivery time-volume relationships. All estimated coefficients are statistically significant at the 1 percent level. For the CCCMA, 81.8 percent of the variation in total delivery time was associated with variation in delivery volume per stop, while for the SMMA the percentage was 61.8. Delivery time-volume relationships for full-service deliveries to schools were not considered separately since there were too few observations of school deliveries at which the required full-service delivery functions were performed.

Equations (12) through (15) are depicted graphically in Figure 3. As for the basic delivery time-volume relationships, alternative functional forms were fitted to the total delivery time-volume data, but the equations reported provided the best fit of the data. Like the BDT-$V_s$ relationships previously developed, the TDT-$V_s$ relationship in each marketing area is kinked reflecting different input-output relationships for small-volume versus large-volume deliveries due to use of different equipment and work methods.

*Miscellaneous Time*

In addition to time spent driving the delivery truck and actually making deliveries, the route driver spends some time on other activities. These activities include warming up the truck and checking the truck before starting the route, rearranging the load while

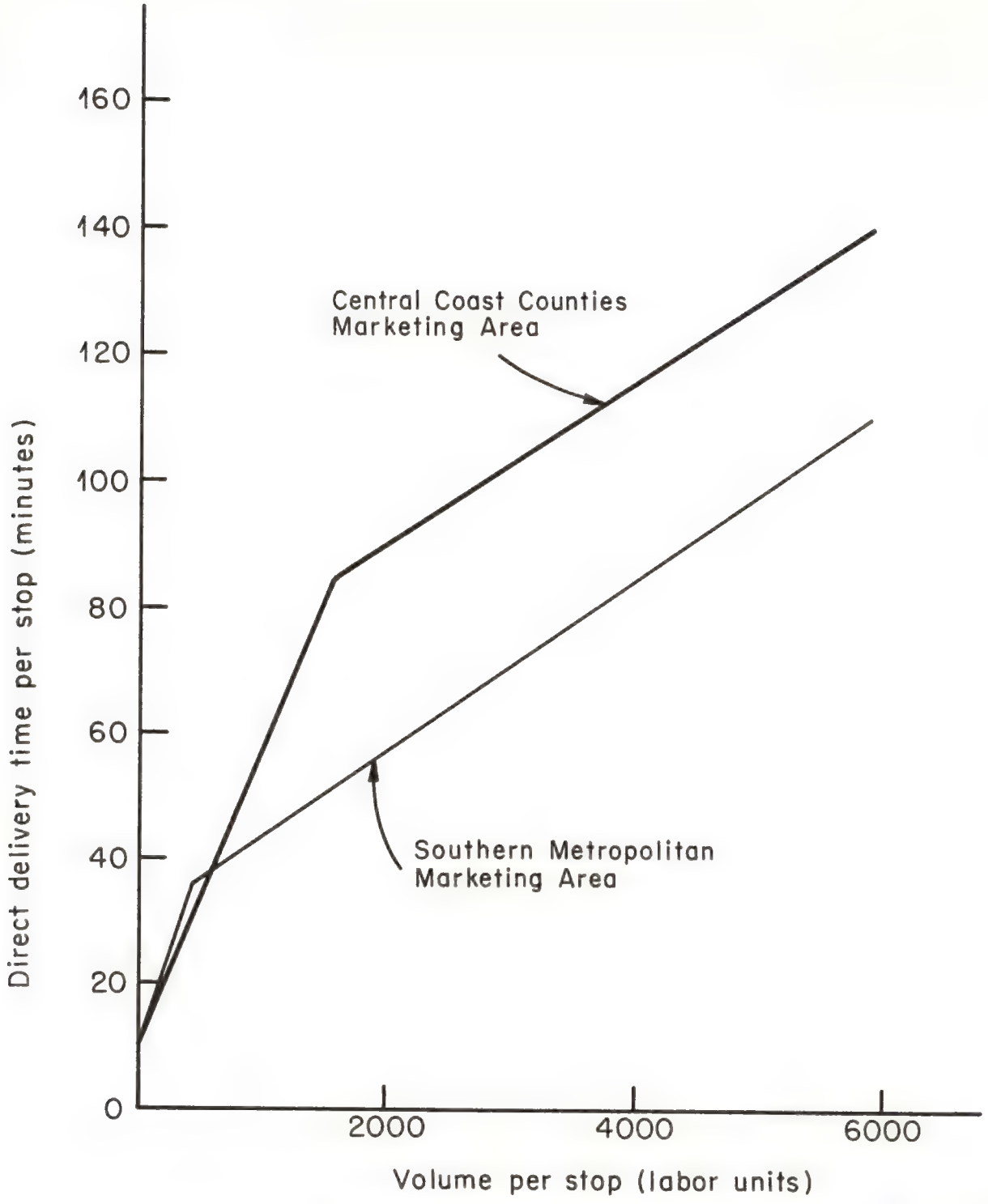


FIGURE 3 Effect of Delivery Volume Per Stop on Time Required for Performing Full-Service Delivery Functions, Wholesale Milk Delivery Routes, Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

on the route, waiting for space at unloading docks, waiting for customer to open for business, attending to personal needs, coffee breaks, fueling truck, parking truck on return to plant, making up orders for next day's deliveries, turning in cash at end of day, and so forth. Time required for such activities is denoted as miscellaneous time and was separated into three components as follows: (1) time at plant before delivery, (2) miscellaneous time while on route,[18] and (3) time at plant after delivery.

For each of the components of miscellaneous time, an analysis was conducted to ascertain if there was a relationship between route volume and/or the number of customers per route and the time spent on the miscellaneous activities. No significant relationships were found in these analyses. Since route volume and number of customers per route are indicated to have little influence on the amount of time spent on miscellaneous route activities, the averages for the three components of miscellaneous time on the routes observed were summed and used in this study. These averages are reported in Table 6.

For both truck types in both marketing areas, miscellaneous time is much greater than the 88.3 minutes for miscellaneous time observed in the 1959 study.[19] A large part of the increase is due to a larger component of miscellaneous time while on the route. Such increases are partly due to the increased use of unloading docks at customer stops and congestion among delivery trucks using these facilities. Waiting for space at unloading docks was frequently observed on the routes studied and varied from a few minutes to almost an hour. Considerable waiting time required for the driver to obtain a signature for a delivery order was also frequently observed along with time spent waiting for a customer to open for business in order to begin making a delivery.

*Total Time*

Relationships between time requirements and variables influencing time requirements for individual components of wholesale milk delivery routes have now been estimated. These relationships are summarized in Tables 7 and 8 for the two marketing areas. Direct delivery time-volume relationships presented in the tables pertain to full-service delivery operations at all types of stops and to limited-service delivery operations at all types of stops excluding schools.

For a specified type of delivery service and delivery equipment, equations presented in either Table 7 or Table 8 can be combined to obtain expressions for total time required on wholesale routes as a function of number of customer stops per route, delivery volume per stop, and miles driven per route. For example, in the CCCMA, total time requirements for providing limited-service deliveries on routes using single-unit trucks are obtained as:

$$T = 135.99 + 7.6375C + 1.20M + \sum_{i=1}^{C} 0.02946\ V_{si} \qquad (16)$$

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[18] Excluding lunch time.

[19] Forker and Clarke, *op. cit.*, p. 23.

TABLE 6

Average Time Spent for Miscellaneous Activities on Wholesale Milk Delivery Routes by Type of Delivery Unit, Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

| Miscellaneous time component | Marketing area | | | |
|---|---|---|---|---|
| | Central Coast Counties | | Southern Metropolitan | |
| | Average time per route | | | |
| | Single-unit trucks | Tractor-trailer units | Single-unit trucks | Tractor-trailer units |
| | minutes | | | |
| Time at plant before delivery | 21.3 | 19.8 | 32.9 | 27.1 |
| Miscellaneous time on route | 40.2 | 52.3 | 52.2 | 67.2 |
| Time at plant after delivery | 47.1 | 35.8 | 50.7 | 23.4 |
| Total | 108.6 | 107.9 | 135.8 | 117.7 |

TABLE 7

Summary of Time Requirements for Wholesale Milk Delivery Routes
Central Coast Counties Marketing Area, 1970-71

| Time component | Fixed time per day | Time per customer | | Time per mile |
|---|---|---|---|---|
| | | Fixed | Variable | |
| | minutes | | | |
| Driving | | | | |
| Single-unit truck | 29.54 | 2.15[a/] | | 1.20 |
| Tractor-trailer unit | 23.87 | 9.42[a/] | | 1.26 |
| Direct delivery | | | | |
| Limited service[b/] | | | | |
| Volume per stop ≤ 1,363 labor units | | 5.4875 | 0.02946 $V_s$ | |
| Volume per stop > 1,363 labor units | | 42.0244 | 0.002657 $V_s$ | |
| Full service[c/] | | | | |
| Volume per stop ≤ 1,545 labor units | | 11.3745 | 0.04740 $V_s$ | |
| Volume per stop > 1,545 labor units | | 64.8864 | 0.01276 $V_s$ | |
| Miscellaneous | | | | |
| Single-unit truck | 108.6 | | | |
| Tractor-trailer unit | 107.9 | | | |

a/ Pertains to one less than the number of customers served per route.

b/ Excludes deliveries to schools.

c/ Includes deliveries to schools.

TABLE 8

Summary of Time Requirements for Wholesale Milk Delivery Routes
Southern Metropolitan Marketing Area, 1970-71

| Time component | Fixed time per day | Time per customer | | Time per mile |
|---|---|---|---|---|
| | | Fixed | Variable | |
| | minutes | | | |
| Driving | | | | |
| Single-unit truck | 29.54 | 2.15[a/] | | 1.20 |
| Tractor-trailer unit | 23.87 | 9.42[a/] | | 1.26 |
| Direct delivery | | | | |
| Limited service[b/] | | | | |
| Volume per stop ≤ 733 labor units | | 6.1808 | 0.02768 $V_s$ | |
| Volume per stop > 733 labor units | | 23.5425 | 0.004009 $V_s$ | |
| Full service[c/] | | | | |
| Volume per stop ≤ 411 labor units | | 11.0753 | 0.05898 $V_s$ | |
| Volume per stop > 411 labor units | | 29.6900 | 0.01366 $V_s$ | |
| Miscellaneous | | | | |
| Single-unit truck | 135.8 | | | |
| Tractor-trailer unit | 117.7 | | | |

a/ Pertains to one less than the number of customers served per route.

b/ Excludes deliveries to schools.

c/ Includes deliveries to schools.

for delivery volume per stop of 1,363 units or less and

$$T = 135.99 + 44.1744C + 1.20M + \sum_{i=1}^{C} 0.002657\ V_{si} \qquad (17)$$

for delivery volume per stop of more than 1,363 units where

T = total time required per route (minutes)

C = number of customer stops per route

M = total miles driven per route

$V_{si}$ = number of labor units delivered at the *i*th stop.

In the above equations, total variable direct delivery time per route is obtained by summing variable direct delivery time per stop over all stops. By substituting average delivery volume per stop ($\bar{V}_s$) for $V_{si}$, the summation can be eliminated and total variable direct delivery time per route obtained as:[20]

$$DDT_R = C\ (\overline{DDT}) \qquad (18)$$

where

$DDT_R$ = total variable direct delivery time per route (minutes)

C = number of customer stops per route

and

$\overline{DDT}$ = variable direct delivery time associated with the average delivery volume per stop.[21]

---

[20] Substituting $\bar{V}_s$ for $V_{si}$ may result in some loss of accuracy in estimating direct delivery time, especially if there are wide variations in delivery volume per stop on the route. In general, however, the error introduced by making the substitution will not be great.

[21] In equation (16), for example, $\overline{DDT} = 0.02946\ \bar{V}_s$.

Since

$$V_R = C\bar{V}_s \tag{19}$$

where

$V_R$ = delivery volume per route (labor units)

C = number of customer stops per route

and

$\bar{V}_s$ = average delivery volume per stop (labor units)

equations (16) and (17) can be rewritten to show the effect of route volume on total time per route as follows:

$$T = 135.99 + 7.6375 \frac{V_R}{V_s} + 0.02946\ V_R + 1.20M \tag{20}$$

for routes averaging 1,363 labor units or less per stop and

$$T = 135.99 + 44.1744 \frac{V_R}{V_s} + 0.002657\ V_R + 1.20M \tag{21}$$

for routes averaging more than 1,363 labor units per stop.

Equations for both marketing areas showing the effect of route volume on total time per route, by type of delivery service provided, and hauling equipment used are as follows:

*Central Coast Counties Marketing Area*

*Limited-Service Delivery*

*Routes Averaging ⩽ 1,363 Labor Units Per Stop*

Single-unit trucks:

$$T = 135.99 + 7.6375 \frac{V_R}{V_s} + 0.02946\ V_R + 1.20M. \tag{22}$$

Tractor-trailer units:

$$T = 122.35 + 14.9075 \frac{V_R}{V_s} + 0.02946\ V_R + 1.26M. \quad (23)$$

*Routes Averaging > 1,363 Labor Units Per Stop*

Single-unit trucks:

$$T = 135.99 + 44.1744 \frac{V_R}{V_s} + 0.002657\ V_R + 1.20M. \quad (24)$$

Tractor-trailer units:

$$T = 122.35 + 51.4444 \frac{V_R}{V_s} + 0.002657\ V_R + 1.26M. \quad (25)$$

*Full-Service Delivery*

*Routes Averaging ⩽ 1,545 Labor Units Per Stop*

Single-unit trucks:

$$T = 135.99 + 13.5245 \frac{V_R}{V_s} + 0.04740\ V_R + 1.20M. \quad (26)$$

Tractor-trailer units:

$$T = 122.35 + 20.7945 \frac{V_R}{V_s} + 0.04740\ V_R + 1.26M. \quad (27)$$

*Routes Averaging > 1,545 Labor Units Per Stop*

Single-unit trucks:

$$T = 135.99 + 67.0364 \frac{V_R}{V_s} + 0.01276\ V_R + 1.20M. \quad (28)$$

Tractor-trailer units:

$$T = 122.35 + 74.3064 \frac{V_R}{V_s} + 0.01276\ V_R + 1.26M. \quad (29)$$

*Southern Metropolitan Marketing Area*

*Limited-Service Delivery*

*Routes Average ⩽ 733 Labor Units Per Stop*

Single-unit trucks:

$$T = 163.19 + 8.3308 \frac{V_R}{V_s} + 0.02768\ V_R + 1.20M. \quad (30)$$

Tractor-trailer units:

$$T = 132.15 + 15.6008 \frac{V_R}{V_s} + 0.02768\ V_R + 1.26M. \quad (31)$$

*Routes Averaging > 733 Labor Units Per Stop*

Single-unit trucks:

$$T = 163.19 + 25.6925 \frac{V_R}{V_s} + 0.004009\ V_R + 1.20M. \quad (32)$$

Tractor-trailer units:

$$T = 132.15 + 32.9625 \frac{V_R}{V_s} + 0.004009\ V_R + 1.26M. \quad (33)$$

*Full-Service Delivery*

*Routes Averaging ⩽ 411 Labor Units Per Stop*

Single-unit trucks:

$$T = 163.19 + 13.2253 \frac{V_R}{V_s} + 0.05898\ V_R + 1.20M. \quad (34)$$

Tractor-trailer units:

$$T = 132.15 + 20.4953 \frac{V_R}{V_s} + 0.05898\ V_R + 1.26M. \quad (35)$$

*Routes Averaging > 411 Labor Units Per Stop*

Single-unit trucks:

$$T = 163.19 + 31.8400 \frac{V_R}{V_s} + 0.01366\ V_R + 1.20M. \quad (36)$$

Tractor-trailer units:

$$T = 132.15 + 39.1100 \frac{V_R}{V_s} + 0.01366\ V_R + 1.26M. \quad (37)$$

These equations provide the basic input-output information needed for developing delivery costs in a later section of this report.

*OPERATING COSTS*

Operating costs incurred on wholesale milk delivery routes include labor costs and truck costs. These costs are detailed in this section.

*Labor Costs*

Wage rates for wholesale milk delivery route drivers in the Central Coast Counties and Southern Metropolitan Marketing Areas are established in periodic negotiations between labor unions and management of milk distribution firms. The current union contract in each marketing area was used as the basis for developing labor costs.

Labor cost per route day is a function of several factors. First, wage rates are higher for drivers of tractor-trailer units than for drivers of single-unit trucks. Second, labor cost per route day varies as the number of delivery days per week varies. Finally, the time of day at which the route is scheduled to begin also influences labor cost per route day.

In addition to driver wages, labor cost for wholesale milk delivery includes route supervisor wages, employer contributions for pensions, health and welfare programs, sick leave, vacation, holidays, and unemployment and compensation insurance for delivery employees. Information obtained from union representatives, delivery supervision personnel, and individuals in the Bureau of Milk Stabilization was used to specify operating standards upon which labor cost calculations are based. Labor cost was calculated based on an 8-hour-per-day, 5-day-per-week delivery schedule in each marketing area. Costs were calculated both for drivers of single-unit trucks and tractor-trailer delivery units. The calculations do not include any allowance for overtime which is typically paid at 1.5 times the regular hourly rate. Details of the labor cost calculations for both marketing areas are presented in Table 9.

*Truck Operating Costs*

Truck operating costs used in this study are based on information provided by the Bureau of Milk Stabilization. The data were secured from accounting records of milk distributors included in this study as part of the Bureau's continuing study of milk processing and distribution costs. Included in truck operating costs are direct operating costs (such as fuel, oil, tires, repairs, taxes, licenses, insurance, depreciation, and so forth) and expenses for other items (such as supplies, laundry, and operation of a repair garage). The Bureau also provided information concerning total labor units delivered per route day on wholesale routes and the number of wholesale routes operated by each company included in this study. Using this information, truck cost per route day as a function of delivery volume (in labor units) per route was estimated for each truck type and for each marketing area. In both marketing areas the hypothesis that the relationship between truck cost per route day and daily delivery volume for the two delivery units was the same could not be rejected at the 5 percent level of significance. Further, the hypothesis that the truck cost-volume relationships were equal in both marketing areas could not be rejected at the 5 percent level. Thus, truck cost per route day as a function of volume per route is indicated to be the same for both truck types in both marketing areas. The equation expressing this relationship was obtained as follows:

$$TC = 14.5745 + 0.001643\ V_R \qquad (38)$$

TABLE 9

Labor Cost Per Route Day for Wholesale Milk Delivery, Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

| Marketing area and delivery unit | Regular driver[a] | Relief driver[a] | Route supervisor (foreman)[a][b] | Payroll taxes and compensation insurance | Pension, health, and welfare benefits | Total |
|---|---|---|---|---|---|---|
| | dollars per route day | | | | | |
| Central Coast Counties | | | | | | |
| Single unit | 46.63[c] | 4.35[c] | 2.36 | 3.56 | 8.74 | 65.64 |
| Tractor-trailer | 48.52[c] | 4.52[c] | 2.36 | 3.61 | 8.74 | 67.75 |
| Southern Metropolitan | | | | | | |
| Single unit | 41.57 | 3.65 | 2.18 | 3.43 | 6.29 | 57.12 |
| Tractor-trailer | 41.86 | 3.68 | 2.19 | 3.44 | 6.29 | 57.46 |

a/ Cost calculations based on 8 hours per day, 5 days per week. Includes allowance for vacation and paid holidays.

b/ Cost calculations based on 20 routes for each supervisor (foreman).

c/ An additional premium is paid to the driver depending on daily route volume. The schedule of premiums is as follows:

An additional $0.50 per day is paid if route volume is in the range 2,000 to 2,499 labor units.
An additional $1.00 per day is paid if route volume is in the range 2,500 to 2,999 labor units.
An additional $2.00 per day is paid if route volume is in the range 3,000 to 3,499 labor units.
An additional $3.00 per day is paid if route volume is in the range 3,500 to 3,999 labor units.
An additional $4.00 per day is paid if route volume exceeds 4,000 labor units.

where TC is truck cost per route day (dollars) and $V_R$ is volume delivered per route (labor units). This equation indicates that there is a \$14.5745 component of truck cost per route day which does not vary with volume delivered. This component would be expected to include allocations with time and not with delivery volume. In addition to the fixed component of truck cost, there is a variable component indicating that truck cost per route day is expected to increase with route volume at a rate of \$0.001643 per labor unit. Such increases in truck cost as volume per route increases are expected due to larger trucks being used for larger loads, and these trucks have greater rates of gasoline, oil, and tire consumption than do smaller trucks. If larger route volumes are handled by additional trips using smaller trucks, distance traveled on the route would increase with a corresponding increase in truck cost. Equation (38) is depicted graphically in Figure 4.

*Total Delivery Costs*

Estimates of labor requirements, labor costs, and truck costs associated with wholesale milk delivery operations have now been developed. It remains to integrate these components to determine the effect of delivery volume per stop on total delivery cost per labor unit.

Equations (22) through (37) express the total time required on wholesale routes in the two marketing areas as a function of delivery volume per stop, total volume per route, and total mileage driven on the route for different types of delivery service and delivery units. To eliminate the effect of variation in distance traveled on total route time requirements for each type of delivery unit, mileage driven per route was set at the average of all routes observed in each marketing area. Average route distance for single-unit trucks was 43.7 miles in the CCCMA and 56.3 miles in the SMMA. For tractor-trailer units, average distance traveled was 72.3 miles in the CCCMA and 83.0 miles in the SMMA. By specifying mileage per route as a constant, each of the total time equations can be further simplified.

For purposes of this study, 8 hours was specified as the length of the workday. Substituting 8 hours equals 480 minutes as a constant term for the left-hand side of equations (22) through (37) and setting mileage driven per route at the appropriate average distance, total route volume ($V_R$) can be expressed in terms of delivery volume per stop ($V_S$). For example, total volume on routes providing limited-service delivery in the CCCMA can be expressed as:

*Routes Averaging $\leqslant$ 1,262 Labor Units Per Stop*

Single-unit trucks:

$$V_R = \frac{291.57}{7.6375/V_S + 0.02946} \quad . \tag{39}$$

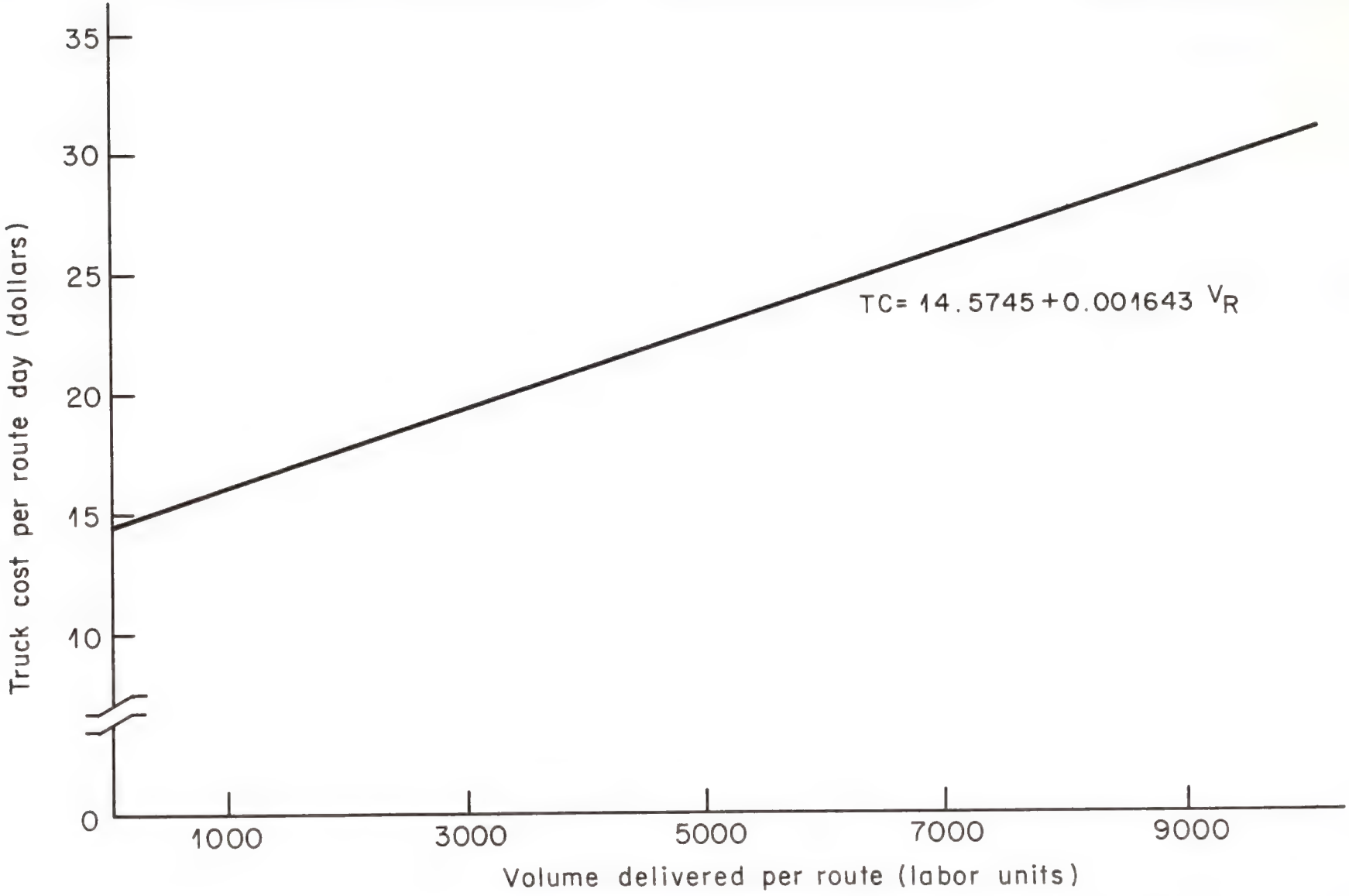


FIGURE 4 Effect of Volume Delivered Per Route on Truck Cost Per Route Day, Wholesale Milk Delivery Routes, Central Coast Counties and Southern Metropolitan Marketing Areas, 1970-71

Tractor-trailer units:

$$V_R = \frac{266.55}{14.9075/V_S + 0.02946}. \quad (40)$$

*Routes Averaging > 1,363 Labor Units Per Stop*

Single-unit trucks:

$$V_R = \frac{291.57}{44.1744/V_S + 0.002657}. \quad (41)$$

Tractor-trailer units:

$$V_R = \frac{266.55}{51.4444/V_S + 0.002657}. \quad (42)$$

Alternative levels of delivery volume per stop are specified in column 1 of Table 10. Equations (39) to (42) are used to calculate total route volumes associated with providing limited-service deliveries in the CCCMA for the varying values of $V_S$. These results are shown in column 2 of Table 10.[22]

Column 3 of Table 10 shows labor cost per route day obtained from Table 9. Truck cost per route day reported in Table 10 was obtained by substituting the route volume from column 2 into equation (38) which expresses truck cost as a function of route volume. Total delivery cost per route day (column 5) was obtained by summing labor cost and truck cost. Total delivery cost expressed on a labor unit basis (column 6) was obtained by dividing total delivery cost per route day by route volume. Unit delivery cost declines markedly as delivery volume per stop increases. For a delivery volume per stop of 10 labor units, unit delivery cost is estimated to be $0.2199, while for a volume per stop of 5,000 units delivery cost is estimated as only $0.0058 per unit.

---

[22] The largest volume per route observed in either the CCCMA or SMMA for which a single-unit truck was used was 9,642 labor units. Based on this observation, 10,000 labor units was selected as an approximation of the capacity of single-unit trucks. Route volumes $\leq$ 10,000 labor units were calculated using equations for single-unit trucks, while equations for tractor-trailer units were used for calculating route volumes which exceeded the capacity of single-unit trucks. For tractor-trailer units, the largest route volume observed in either marketing area was 28,061 labor units. However, this volume required the driver to make an intermediate trip to the plant to return one trailer and pick up another trailer to continue his route. Since there were few such observations, time requirements for these activities were not analyzed. Rather, only single-trip routes are considered in the study. The largest single-trip route volume observed in either marketing area was 22,026 labor units. Based on this observation, 22,500 labor units was selected as an approximation of the capacity of tractor-trailer units. Costs for deliveries resulting in larger route volumes were not developed.

TABLE 10

Estimated Costs for Performing Limited-Service Delivery Functions on Wholesale Milk Routes by Volume Delivered Per Stop, Central Coast Counties Marketing Area, 1970-71

| Volume per stop ($V_s$) | Route volume[a] ($V_R$) | Labor cost per route day[b] | Truck cost per route day[c] | Total cost per route day[d] | Total cost per labor unit[e] |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| labor units | | dollars | | | |
| 10 | 368 | 65.64 | 15.18 | 80.82 | 0.2199 |
| 50 | 1,600 | 65.64 | 17.20 | 82.84 | 0.0518 |
| 100 | 2,755 | 66.64 | 19.10 | 85.74 | 0.0311 |
| 150 | 3,628 | 68.64 | 20.53 | 89.17 | 0.0246 |
| 200 | 4,310 | 69.64 | 21.66 | 91.30 | 0.0212 |
| 250 | 4,859 | 69.64 | 22.56 | 92.20 | 0.0190 |
| 300 | 5,309 | 69.64 | 23.30 | 92.94 | 0.0175 |
| 400 | 6,005 | 69.64 | 24.44 | 94.08 | 0.0157 |
| 500 | 6,518 | 69.64 | 25.28 | 94.92 | 0.0146 |
| 1,000 | 7,860 | 69.64 | 27.49 | 97.13 | 0.0124 |
| 1,500 | 9,081 | 69.64 | 29.50 | 99.14 | 0.0109 |
| 2,000 | 9,392 | 71.75 | 30.01 | 101.76 | 0.0108 |
| 3,000 | 13,459 | 71.75 | 36.69 | 108.44 | 0.0081 |
| 4,000 | 17,177 | 71.75 | 42.80 | 114.55 | 0.0067 |
| 5,000 | 20,590 | 71.75 | 48.40 | 120.15 | 0.0058 |
| 6,000 | 23,733 | 71.75 | 53.57 | 125.32 | 0.0053 |

(Continued on next page.)

TABLE 10--continued.

a/ Route volumes calculated using the equations:

Single-unit trucks:

$$V_R = \frac{291.57}{7.6375/V_s + 0.02946} \quad \text{for routes averaging} \leq 1{,}363 \text{ labor units per stop}$$

and

$$V_R = \frac{291.57}{44.1744/V_s + 0.002657} \quad \text{for routes averaging} > 1{,}363 \text{ labor units per stop.}$$

Tractor-trailer units:

$$V_R = \frac{266.55}{14.9075/V_s + 0.02946} \quad \text{for routes averaging} \leq 1{,}363 \text{ labor units per stop}$$

and

$$V_R = \frac{266.55}{51.4444/V_s + 0.002657} \quad \text{for routes averaging} > 1{,}363 \text{ labor units per stop}$$

where $V_R$ is route volume and $V_s$ is volume per stop.

Equations for the single-unit truck were used for $V_s \leq 1{,}500$ labor units while equations for the tractor-trailer unit were used for $V_s > 1{,}500$ labor units.

b/ Labor costs obtained from Table 9 pertain to drivers of single-unit trucks for $V_s \leq 1{,}500$ labor units and to drivers of tractor-trailer units for $V_s > 1{,}500$ labor units.

c/ $TC = 14.5745 + 0.001643\ V_R$ where TC is truck cost per route day (dollars) and $V_R$ is route volume (labor units).

d/ Labor costs per route day plus truck cost per route day.

e/ Total cost per route day divided by route volume.

Delivery costs for full-service deliveries in the CCCMA are presented in Table 11. Limited-service and full-service delivery costs in the SMMA are presented in Tables 12 and 13, respectively. The same procedures were used in constructing these tables as described for limited-service deliveries in the CCCMA (Table 10).

A comparison of unit delivery costs for limited-service and full-service deliveries in both marketing areas shows that, for any delivery volume per stop, costs for limited-service delivery are less than for full-service delivery. The basic reason for the cost differences is the difference in direct delivery time requirements for the two types of services. The fixed time per stop for full-service delivery is greater than for limited-service delivery, and time increases with delivery volume at a faster rate for full service than for limited service.

Comparing unit costs for both limited-service and full-service deliveries between the two marketing areas shows that, for the smaller volume per stop categories, unit costs are lower in the CCCMA than in the SMMA; but in the larger average volume per stop categories, this relationship is reversed. There are several factors contributing to this result. First, there are differences in the estimated requirements for driving time, direct delivery time, and miscellaneous time between marketing areas. Second, there is a considerable difference in labor cost per route day between the marketing areas. A third factor is the increase in labor cost per route day in the CCCMA as route volume increases. Thus, while unit delivery costs in the CCCMA decline as average volume per stop increases, the decline is not as rapid as in the SMMA resulting in lower unit costs in the SMMA for the larger volume per stop categories.

## *USE OF DELIVERY COST ANALYSIS FOR PRICING*

### *Evaluation of Current Discount Schedules*

One of the objectives of this study is to evaluate the volume-pricing schedules presently established by the Bureau of Milk Stabilization to ascertain if these schedules accurately reflect differences in delivery costs associated with varying delivery volumes. Delivery costs associated with varying delivery volumes per stop have now been developed. However, before results of the delivery cost analysis can be used for evaluating present volume-discount schedules, it is necessary to obtain estimates of costs, other than delivery costs, which are also a factor in determining the level of wholesale milk prices. These nondelivery costs are then combined with the estimated delivery costs to obtain a relationship between delivery volume per stop and unit cost for each type of delivery service. Each of these relationships is compared with the appropriate volume-discount schedule to ascertain the extent to which the discount schedule reflects cost differences associated with differences in delivery volumes.

Nondelivery costs include raw product costs (farm price for milk plus transportation and handling charges incurred for moving the milk from farm to processing plant), processing costs, general and administrative expenses, and selling expenses, plus allowances for taxes and operating margins. While these costs can be expected to vary among milk distributors, an estimate of nondelivery costs for each marketing area was provided by the Bureau of Milk Stabilization.

TABLE 11

Estimated Costs for Performing Full-Service Delivery Functions on Wholesale Milk Routes by Volume Delivered Per Stop, Central Coast Counties Marketing Area, 1970-71

| Volume per stop ($V_s$) | Route volume[a] ($V_R$) | Labor cost per route day[b] | Truck cost per route day[c] | Total cost per route day[d] | Total cost per labor unit[e] |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| labor units | | dollars | | | |
| 10 | 208 | 65.64 | 14.92 | 80.56 | 0.3868 |
| 50 | 917 | 65.64 | 16.08 | 81.72 | 0.0891 |
| 100 | 1,596 | 65.64 | 17.20 | 82.84 | 0.0519 |
| 150 | 2,120 | 66.14 | 18.06 | 84.20 | 0.0397 |
| 200 | 2,535 | 66.64 | 18.74 | 85.38 | 0.0337 |
| 250 | 2,873 | 66.64 | 19.29 | 85.93 | 0.0299 |
| 300 | 3,153 | 67.64 | 19.75 | 87.39 | 0.0277 |
| 400 | 3,590 | 68.64 | 20.47 | 89.11 | 0.0248 |
| 500 | 3,916 | 68.64 | 21.01 | 89.65 | 0.0229 |
| 1,000 | 4,786 | 69.64 | 22.44 | 92.08 | 0.0192 |
| 1,500 | 5,168 | 69.64 | 23.07 | 92.71 | 0.0179 |
| 2,000 | 6,300 | 69.64 | 24.93 | 94.57 | 0.0150 |
| 3,000 | 8,306 | 69.64 | 28.22 | 97.86 | 0.0118 |
| 4,000 | 9,877 | 69.64 | 30.80 | 100.44 | 0.0102 |
| 5,000 | 9,650 | 71.75 | 30.43 | 102.18 | 0.0106 |
| 6,000 | 10,601 | 71.75 | 31.99 | 103.74 | 0.0098 |

(Continued on next page.)

TABLE 11--continued.

a/ Route volumes calculated using the equations:

Single-unit trucks:

$$V_R = \frac{291.57}{13.5245/V_s + 0.04740} \quad \text{for routes averaging} \leq 1{,}545 \text{ labor units per stop}$$

and

$$V_R = \frac{291.57}{67.0364/V_s + 0.01276} \quad \text{for routes averaging} > 1{,}545 \text{ labor units per stop.}$$

Tractor-trailer units:

$$V_R = \frac{266.55}{20.7945/V_s + 0.04740} \quad \text{for routes averaging} \leq 1{,}545 \text{ labor units per stop}$$

and

$$V_R = \frac{266.55}{74.3064/V_s + 0.01276} \quad \text{for routes averaging} > 1{,}545 \text{ labor units per stop}$$

where $V_R$ is route volume and $V_s$ is volume per stop.

Equations for the single-unit truck were used for $V_s \leq 5{,}000$ labor units while equations for the tractor-trailer unit were used for $V_s > 5{,}000$ labor units.

b/ Labor costs obtained from Table 9 pertain to drivers of single-unit trucks for $V_s \leq 5{,}000$ labor units and to drivers of tractor-trailer units for $V_s > 5{,}000$ labor units.

c/ $TC = 14.5745 + 0.001643\, V_R$ where TC is truck cost per route day (dollars) and $V_R$ is route volume (labor units).

d/ Labor costs per route day plus truck cost per route day.

e/ Total cost per route day divided by route volume.

TABLE 12

Estimated Costs for Performing Limited-Service Delivery Functions on Wholesale Milk Routes by Volume Delivered Per Stop, Southern Metropolitan Marketing Area, 1970-71

| Volume per stop ($V_s$) | Route volume[a] ($V_R$) | Labor cost per route day[b] | Truck cost per route day[c] | Total cost per route day[d] | Total cost per labor unit[e] |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| labor units | | dollars | | | |
| 10 | 290 | 57.12 | 15.05 | 72.17 | 0.2492 |
| 50 | 1,283 | 57.12 | 16.68 | 73.80 | 0.0575 |
| 100 | 2,246 | 57.12 | 18.26 | 75.38 | 0.0336 |
| 150 | 2,995 | 57.12 | 19.50 | 76.62 | 0.0256 |
| 200 | 3,595 | 57.12 | 20.48 | 77.60 | 0.0216 |
| 250 | 4,086 | 57.12 | 21.29 | 78.41 | 0.0192 |
| 300 | 4,495 | 57.12 | 21.96 | 79.08 | 0.0176 |
| 400 | 5,138 | 57.12 | 23.02 | 80.14 | 0.0156 |
| 500 | 5,621 | 57.12 | 23.81 | 80.93 | 0.0144 |
| 1,000 | 8,392 | 57.12 | 28.36 | 85.48 | 0.0102 |
| 1,500 | 9,362 | 57.46 | 29.96 | 87.42 | 0.0093 |
| 2,000 | 11,872 | 57.46 | 34.08 | 91.54 | 0.0077 |
| 3,000 | 16,222 | 57.46 | 41.23 | 98.69 | 0.0061 |
| 4,000 | 19,859 | 57.46 | 47.20 | 104.66 | 0.0953 |

(Continued on next page.)

TABLE 12--continued.

a/ Route volumes calculated using the equations:

Single-unit trucks:

$$V_R = \frac{249.25}{8.3308/V_s + 0.02768} \quad \text{for routes averaging} \leq 733 \text{ labor units per stop}$$

and

$$V_R = \frac{249.25}{25.6925/V_s + 0.004009} \quad \text{for routes averaging} > 733 \text{ labor units per stop.}$$

Tractor-trailer units:

$$V_R = \frac{243.27}{15.6008/V_s + 0.02768} \quad \text{for routes averaging} \leq 733 \text{ labor units per stop}$$

and

$$V_R = \frac{243.27}{32.7625/V_s + 0.004009} \quad \text{for routes averaging} > 733 \text{ labor units per stop}$$

where $V_R$ is route volume and $V_s$ is volume per stop.

Equations for the single-unit truck were used for $V_s \leq 1{,}000$ labor units while equations for the tractor-trailer unit were used for $V_s > 1{,}000$ labor units.

b/ Labor costs obtained from Table 9 pertain to drivers of single-unit trucks for $V_s \leq 1{,}000$ labor units and to drivers of tractor-trailer units for $V_s > 1{,}000$ labor units.

c/ $TC = 14.5745 + 0.001643\ V_R$ where TC is truck cost per route day (dollars) and $V_R$ is route volume (labor units).

d/ Labor costs per route day plus truck cost per route day.

e/ Total cost per route day divided by route volume.

TABLE 13

Estimated Costs for Performing Full-Service Delivery Functions on Wholesale Milk Routes by Volume Delivered Per Stop, Southern Metropolitan Marketing Area, 1970-71

| Volume per stop ($V_s$) | Route volume[a] ($V_R$) | Labor cost per route day[b] | Truck cost per route day[c] | Total cost per route day[d] | Total cost per labor unit[e] |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| labor units | | dollars | | | |
| 10 | 180 | 57.12 | 14.87 | 71.99 | 0.3990 |
| 50 | 771 | 57.12 | 15.84 | 72.96 | 0.0947 |
| 100 | 1,303 | 57.12 | 16.72 | 73.84 | 0.0566 |
| 150 | 1,694 | 57.12 | 17.36 | 74.48 | 0.0440 |
| 200 | 1,992 | 57.12 | 17.85 | 74.97 | 0.0376 |
| 250 | 2,228 | 57.12 | 18.23 | 75.35 | 0.0338 |
| 300 | 2,418 | 57.12 | 18.55 | 75.67 | 0.0313 |
| 400 | 2,708 | 57.12 | 19.02 | 76.14 | 0.0281 |
| 500 | 3,223 | 57.12 | 19.87 | 76.99 | 0.0239 |
| 1,000 | 5,478 | 57.12 | 23.57 | 80.69 | 0.0147 |
| 1,500 | 7,145 | 57.12 | 26.31 | 83.43 | 0.0117 |
| 2,000 | 8,426 | 57.12 | 28.42 | 85.54 | 0.0102 |
| 3,000 | 9,112 | 57.46 | 29.55 | 87.01 | 0.0095 |
| 4,000 | 10,380 | 57.46 | 31.63 | 89.09 | 0.0086 |
| 5,000 | 11,324 | 57.46 | 33.18 | 90.64 | 0.0080 |
| 6,000 | 12,056 | 57.46 | 34.38 | 91.84 | 0.0076 |
| 7,000 | 12,639 | 57.46 | 35.34 | 92.80 | 0.0073 |

(Continued on next page.)

TABLE 13--continued.

a/ Route volumes calculated using the equations:

Single-unit trucks:

$$V_R = \frac{249.25}{13.2253/V_s + 0.05898} \quad \text{for routes averaging} \leq 411 \text{ labor units per stop}$$

and

$$V_R = \frac{249.25}{31.8400/V_s + 0.01366} \quad \text{for routes averaging} > 411 \text{ labor units per stop.}$$

Tractor-trailer units:

$$V_R = \frac{243.27}{20.4953/V_s + 0.05898} \quad \text{for routes averaging} \leq 411 \text{ labor units per stop}$$

and

$$V_R = \frac{243.27}{39.1100/V_s + 0.01366} \quad \text{for routes averaging} > 411 \text{ labor units per stop}$$

where $V_R$ is rate volume and $V_s$ is volume per stop.

Equations for the single-unit truck were used for $V_s \leq 2{,}000$ labor units while equations for the tractor-trailer unit were used for $V_s > 2{,}000$ labor units.

b/ Labor costs obtained from Table 9 pertain to drivers of single-unit trucks for $V_s \leq 2{,}000$ labor units and to drivers of tractor-trailer units for $V_s > 2{,}000$ labor units.

c/ $TC = 14.5745 + 0.001643\, V_R$ where TC is truck cost per route day (dollars) and $V_R$ is route volume (labor units).

d/ Labor costs per route day plus truck cost per route day.

e/ Total cost per route day divided by route volume.

The one-half gallon container was selected for use in evaluating present volume discount schedules since it is the predominant container type delivered on wholesale milk routes in the two marketing areas. Nondelivery costs for fluid milk packaged in one-half gallon containers were estimated to be $0.3907 in the CCCMA and $0.3869 in the SMMA. Expressed on a labor unit basis, these costs are $0.19535 in the CCCMA and $0.19345 in the SMMA.

Figure 5 shows the CCCMA unit cost-volume relationships for full-service and limited-service deliveries obtained by adding nondelivery costs to delivery costs associated with varying delivery volumes. Figure 6 depicts similar results for the SMMA. Figure 5 also shows the current CCCMA limited-service and full-service volume-discount schedules (expressed on a labor unit basis) for fluid milk packaged in one-half gallon containers. The corresponding volume-discount schedules for the SMMA are shown in Figure 6. If the discount schedules are to be effective in reflecting cost differences for varying delivery volumes, each discount schedule should closely approximate the respective nondelivery plus delivery unit cost function throughout the entire range of delivery volumes.

In both the CCCMA and SMMA, full-service deliveries of very small volumes result in unit costs which exceed the price established for such delivery volumes. As previously noted by Forker and Clarke,[23] this result stems from the interaction of two policies established by the Bureau of Milk Stabilization. First, the Bureau establishes a uniform minimum retail price. Second, the minimum retail price must provide some margin for all wholesale customers. To maintain both these policies, the base price charged all customers, regardless of volume purchased, must be set relatively low resulting in wholesale prices for small-volume, full-service deliveries which are less than costs.

With the exception of the small-volume deliveries previously discussed, effective prices for full-service delivery in the CCCMA exceed costs for all delivery volumes. Further, the difference between costs and effective prices increases as delivery volume increases.

For fluid milk in one-half gallon containers, a limited-service discount schedule for the CCCMA is only defined for delivery volumes larger than 460 labor units. While limited-service deliveries of smaller volumes are feasible and estimated costs for such deliveries are depicted in Figure 5, the Bureau of Milk Stabilization's policy has been to restrict limited-service discounts to the larger volume deliveries. Throughout the range of delivery volumes for which effective prices for limited-service deliveries are established, unit costs are less than the effective price. As for full-service deliveries, the difference between unit cost and effective price becomes larger as delivery volume increases.

Comparison of unit costs and effective prices for both limited-service and full-service deliveries in the SMMA reveals the same general results as obtained for the CCCMA. However, the SMMA limited-service discount schedule does conform closely to unit cost for delivery volumes in the range of 1,500 to 3,000 labor units.

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[23] Forker and Clarke, *op. cit.*, p. 34.

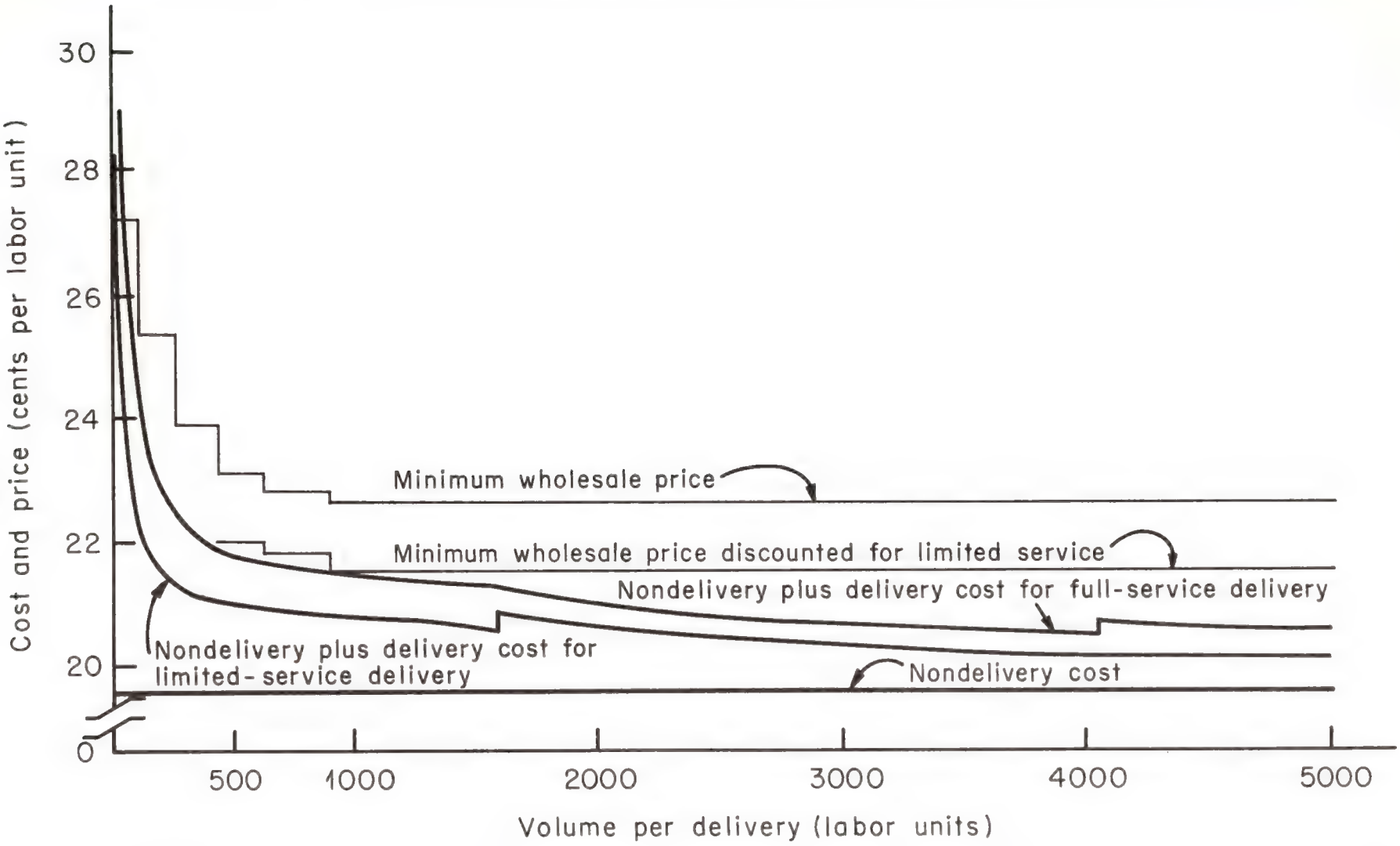


FIGURE 5 Minimum Wholesale Prices for Fluid Milk in One-Half Gallon Containers and Estimated Nondelivery and Delivery Costs for Varying Delivery Volumes Per Stop, Wholesale Milk Routes, Central Coast Counties Marketing Area, 1970-71

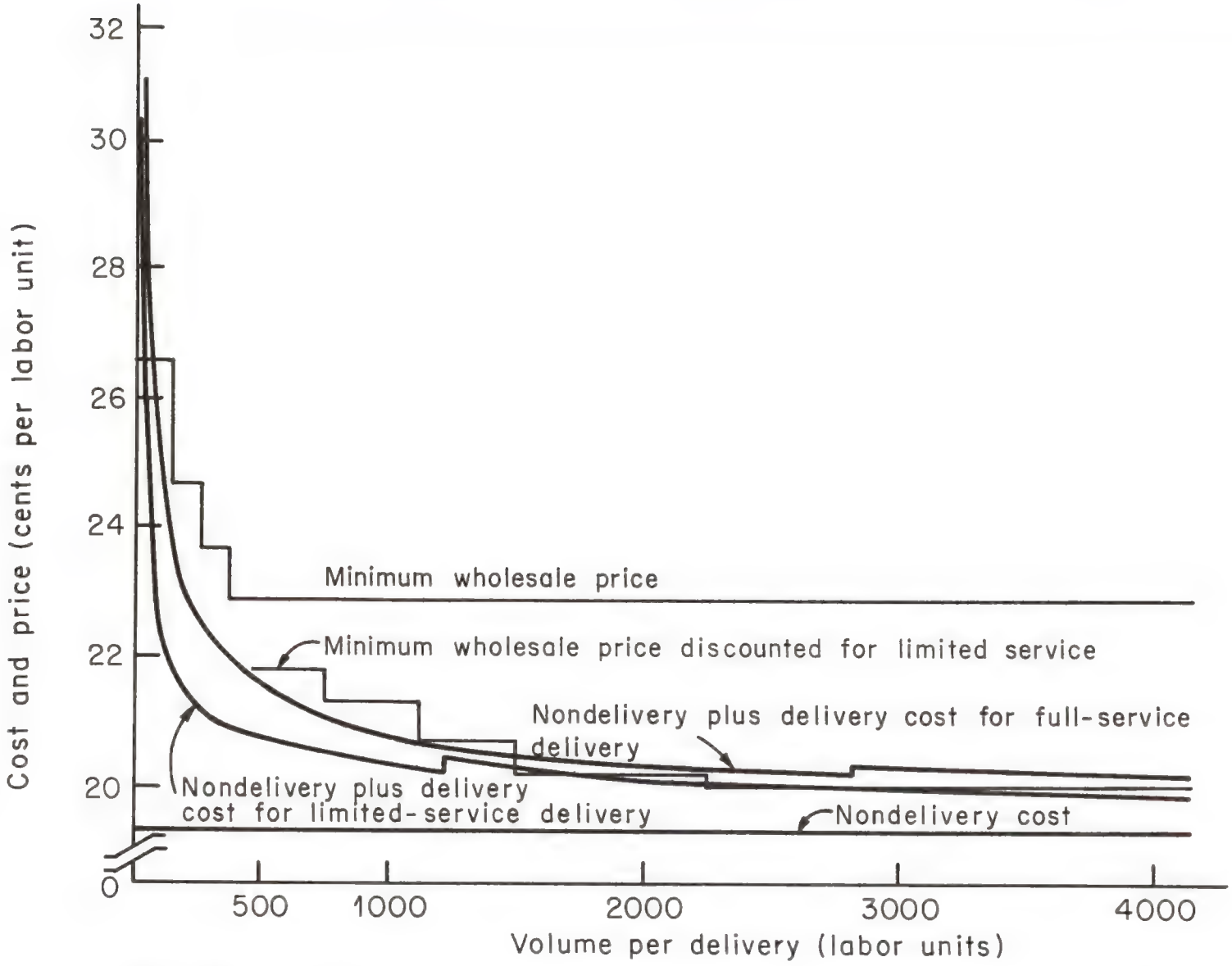


FIGURE 6 Minimum Wholesale Prices for Fluid Milk in One-Half Gallon Containers, Estimated Nondelivery and Delivery Costs for Varying Delivery Volumes Per Stop, Wholesale Milk Routes, Southern Metropolitan Marketing Area, 1970-71

The above results suggest that some modifications of volume-discount schedules in the two marketing areas being considered are needed in order to accurately reflect cost differences associated with varying delivery volumes. With the exception of the very small delivery volumes, larger discounts are needed along with additional discount brackets for the largest deliveries. By altering the number of discount brackets and the amount of the percentage discount applicable to each bracket, the existing type of discount schedule can be made to closely conform to the unit cost-volume function. However, there are practical problems encountered in such an attempt. First, it would be necessary to use fractional percentages in stating discounts which increase computational difficulties. Using discount rates stated only in integer values reduces the accuracy of the bracket discount pricing schedule in reflecting cost differences. Second, a relatively large number of different discount brackets would be needed, each bracket applicable to only a small range of delivery volumes. While use of a large number of brackets increases accuracy of the discount schedule in reflecting cost differences, it increases the complexity of calculations for milk distributors. Reducing the number of brackets reduces the computational difficulties but results in less accuracy in reflecting differential costs. Thus, while the existing type of volume discount schedule might be modified to more closely approximate costs associated with varying delivery volumes, increased accuracy can only be achieved at the expense of increased computational difficulties.

As an alternative to modifying the bracket-type volume discount schedule, a different method of establishing minimum prices for varying delivery volumes can be devised. This method is based on the use of a service charge-type pricing schedule. Using this method, each customer pays a fixed charge per delivery plus a base price per unit delivered. Use of this procedure eliminates the need for determining the range of delivery volumes for which a given percentage discount is to apply and the amount of discount allowed for each range of delivery volumes.

Given the information in Tables 10, 11, 12, and 13, equations expressing total delivery cost per stop as a function of delivery volume per stop can be derived for each type of delivery service in each marketing area. These equations are as follows:

*Central Coast Counties Marketing Area*

*Limited Service*

$$TC_s = 2.1590 + 0.010200\ V_s \quad \text{for } V_s \leqslant 1{,}363 \tag{43}$$

$$TC_s = 12.7556 + 0.002415\ V_s \quad \text{for } 1{,}363 < V_s < 1{,}667 \tag{44}$$

$$TC_s = 16.6654 + 0.002503\ V_s \quad \text{for } V_s \geqslant 1{,}667 \tag{45}$$

*Full Service*

$$TC_s = 3.7038 + 0.015508\ V_s \quad \text{for } V_s \leqslant 1{,}545 \tag{46}$$

$$TC_s = 19.3597 + 0.005330\ V_s \quad \text{for } 1{,}545 < V_s < 4{,}089 \tag{47}$$

$$TC_s = 24.0463 + 0.005779\ V_s \quad \text{for } V_s \geqslant 4{,}089 \tag{48}$$

*Southern Metropolitan Marketing Area*

*Limited Service*

$$TC_s = 2.3939 + 0.009613\ V_s \quad \text{for } V_s \leqslant 733 \tag{49}$$

$$TC_s = 7.3766 + 0.002811\ V_s \quad \text{for } 733 < V_s < 1{,}229 \tag{50}$$

$$TC_s = 9.7612 + 0.002830\ V_s \quad \text{for } V_s \geqslant 1{,}229 \tag{51}$$

*Full Service*

$$TC_s = 3.8040 + 0.018603\ V_s \quad \text{for } V_s \leqslant 411 \tag{52}$$

$$TC_s = 9.1536 + 0.005574\ V_s \quad \text{for } 411 < V_s < 2{,}827 \tag{53}$$

$$TC_s = 11.5880 + 0.005687\ V_s \quad \text{for } V_s \geqslant 2{,}827 \tag{54}$$

where $TC_s$ is total delivery cost per stop (dollars) and $V_s$ is delivery volume per stop (labor units).

Each cost function relating delivery cost per stop to volume delivered per stop is composed of three linear segments. That portion of each cost function applicable to the smallest delivery volumes pertains to use of the single-unit truck. The second portion of each cost function also pertains to use of the single-unit truck but has a different slope due to the nature of the direct delivery time-volume relationships. The portion of each cost function applicable to the largest delivery volumes pertains to use of the

tractor-trailer unit. The equations are depicted graphically in Figures 7 and 8 and illustrate the fact that there is a fixed component of delivery cost associated with each stop which is independent of delivery volume. Within each of the three segments of each cost function, delivery cost per stop increases with volume at a constant rate.

For each type of delivery service in both marketing areas, the coefficient of $V_s$ in the third segment of the delivery cost per stop-volume delivered per stop function exceeds the coefficient of $V_s$ in the second segment. This result at first seems surprising since the only distinction between the two segments is that the second segment is based on use of a single-unit truck, while the third segment is based on use of the tractor-trailer unit. Input-output relationships for direct delivery operations are the same for both types of units. Two factors explain the observed differences. First, in both marketing areas the wage rate for the driver of a tractor-trailer unit exceeds that of the single-unit truck driver. This means that, even with the same delivery time-volume relationships for the two types of delivery units, cost increases with volume at a greater rate when a tractor-trailer unit is being used than when a single-unit truck is used. Second, calculating delivery cost on a per stop basis results in total route cost being allocated only to the time actually spent performing delivery functions. Due to greater driving time requirements on routes for which tractor-trailer units are used, less time is available for actually making deliveries. Thus, the cost per unit of time for performing direct delivery functions is greater for a tractor-trailer unit than for a single-unit truck. This is an additional factor causing delivery cost per stop to increase with volume delivered at a faster rate when a tractor-trailer unit is used than when a single-unit truck is used.

Adding nondelivery costs to the delivery cost per stop equations provides cost functions expressing total unit cost as a function of delivery volume per stop. Using these results, service-charge type volume pricing schedules for fluid milk in one-half gallon containers are obtained as:

*Central Coast Counties Marketing Area*

*Limited Service*

*Deliveries $\leq$ 1,884 labor units*

Service charge of $2.16 per delivery plus a base price of 20.6 cents per labor unit.

*Deliveries $>$ 1,884 labor units*

Service charge of $16.67 per delivery plus a base price of 19.8 cents per labor unit.

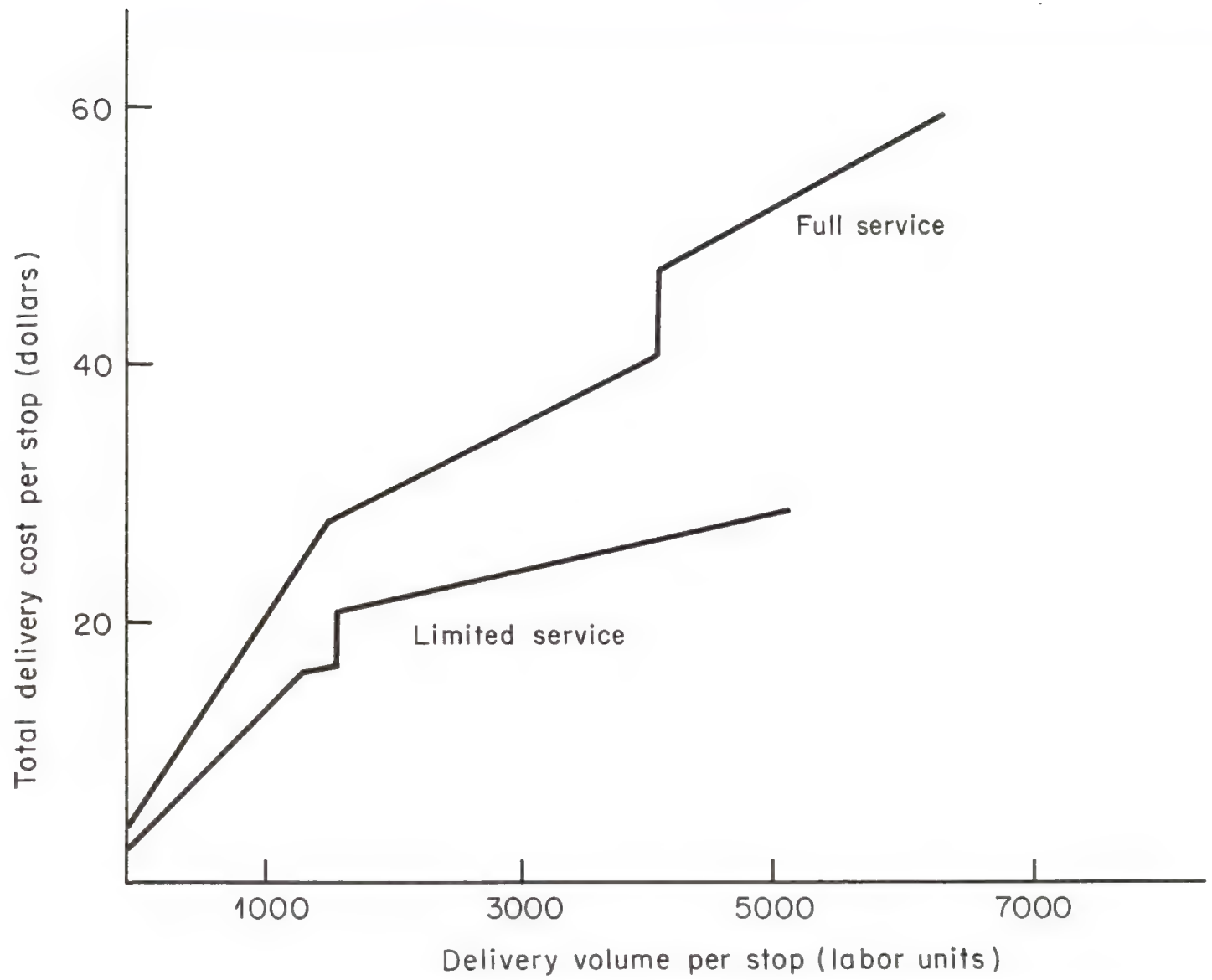


FIGURE 7 Estimated Total Delivery Costs Per Stop on Wholesale Milk Routes by Volume Delivered Per Stop and Type of Service Provided, Central Coast Counties Marketing Area, 1970-71

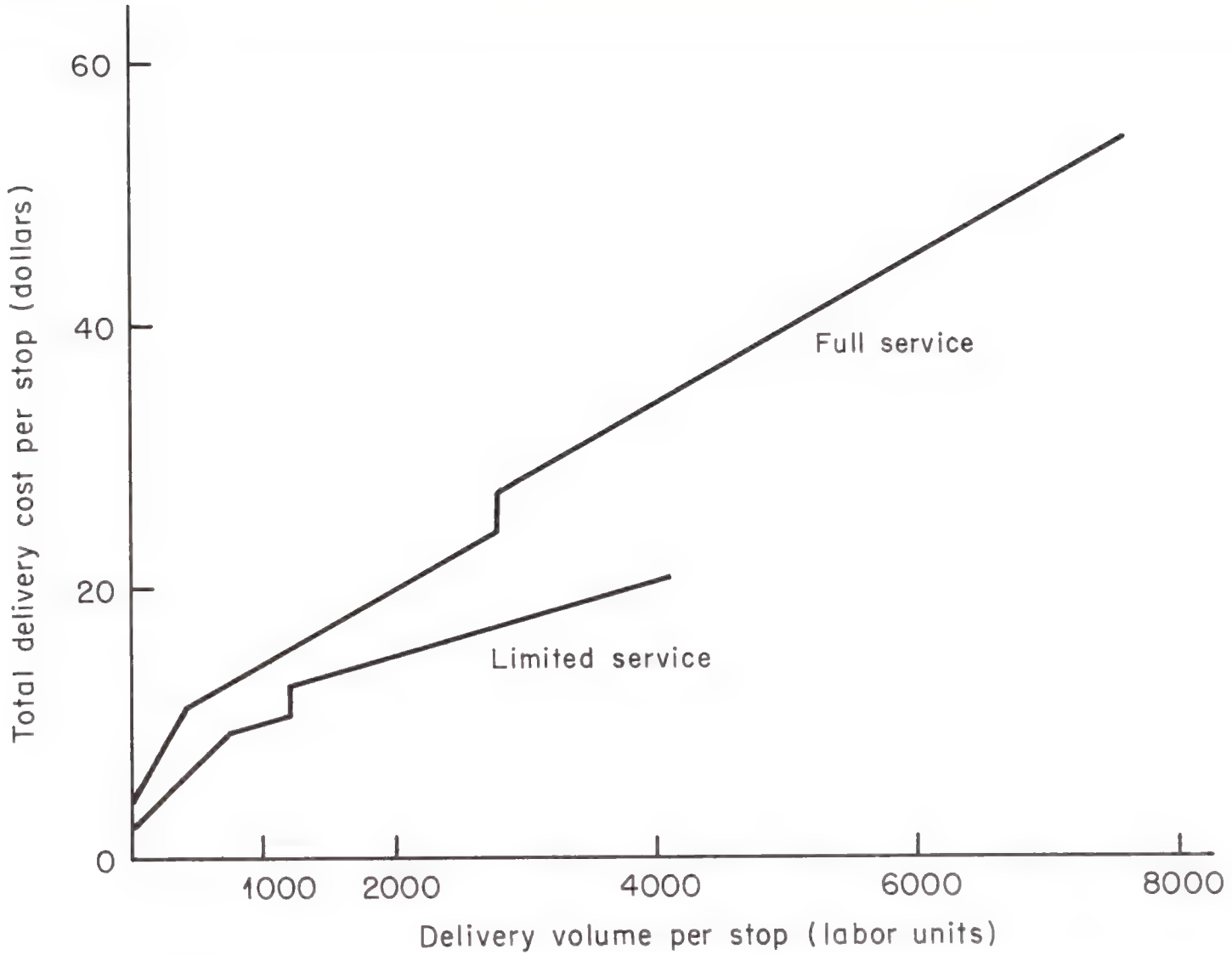


FIGURE 8 Estimated Total Delivery Costs Per Stop on Wholesale Milk Routes by Volume Delivered Per Stop and Type of Service Provided, Southern Metropolitan Marketing Area, 1970-71

*Full Service*

*Deliveries ⩽ 1,545 labor units*

Service charge of $3.70 per delivery plus a base price of 21.1 cents per labor unit.

*Deliveries > 1,545 labor units but < 4,089 labor units*

Service charge of $15.41 per delivery plus a base price of 20.3 cents per labor unit.

*Deliveries ⩾ 4,089 labor units*

Service charge of $24.05 per delivery plus a base price of 20.1 cents per labor unit.

*Southern Metropolitan Marketing Area*

*Limited Service*

*Deliveries ⩽ 733 labor units*

Service charge of $2.39 per delivery plus a base price of 20.3 cents per labor unit.

*Deliveries > 733 labor units but < 1,229 labor units*

Service charge of $3.82 per delivery plus a base price of 20.1 cents per labor unit.

*Deliveries ⩾ 1,229 labor units*

Service charge of $9.76 per delivery plus a base price of 19.6 cents per labor unit.

*Full Service*

*Deliveries ⩽ 411 labor units*

Service charge of $3.80 per delivery plus a base price of 21.1 cents per labor unit.

*Deliveries > 411 labor units but < 2,827 labor units*

Service charge of $8.69 per delivery plus a base price of 20.0 cents per labor unit.

*Deliveries ⩾ 2,827 labor units*

Service charge of $11.59 per delivery plus a base price of 19.9 cents per labor unit.

With the exception of the CCCMA limited-service schedule, each pricing schedule is composed of three segments. The first and third segments of each schedule are based on the first and third segments, respectively, of the appropriate total delivery cost function. However, the second segment of each pricing schedule does not adhere to the second segment of the appropriate total delivery cost function. Within the range of delivery volumes for which the second segment of each pricing schedule applies, the schedule reflects costs which are intermediate between costs associated with the single-unit truck and the tractor-trailer unit. In effect, as delivery volume increases in this range, prices established reflect a transition from single-unit truck costs to tractor-trailer costs. While the single-unit truck provides lower unit costs than does the tractor-trailer unit throughout this range of delivery volume, it is to be expected that there is a range of delivery volumes for which different delivery units may be used by different distributors due to truck availability and route-scheduling problems. The procedure used reflects use of a combination of truck types within a specified range of delivery volumes.

For the CCCMA limited-service pricing schedule, the above procedure was not followed due to the nature of the cost functions which would have resulted in a negative service charge for delivery volumes in the second segment. While a pricing schedule incorporating a negative service charge could have been developed, it was not done to avoid complexity in pricing computations. Rather, the CCCMA limited-service pricing schedule contains only two segments, the first segment based on the first segment of the total cost function and the second segment based on the third segment of the total cost function. For delivery volumes in the range of 1,363 to 1,884 labor units, prices are established based on an extension of the first segment of the total cost function. Use of this procedure results in the effective prices which are slightly below costs for delivery volumes in the range of 1,667 to 1,884 labor units, but the difference is quite small.

Total unit costs for the CCCMA as a function of delivery volume per stop for fluid milk in one-half gallon containers are shown in Figure 9. Effective prices which would result from use of the service charge-type pricing schedule are also depicted in Figure 9. Similar information for the SMMA is presented in Figure 10. Using this type of pricing schedule, effective prices conform closely to the unit cost functions for all delivery volumes.

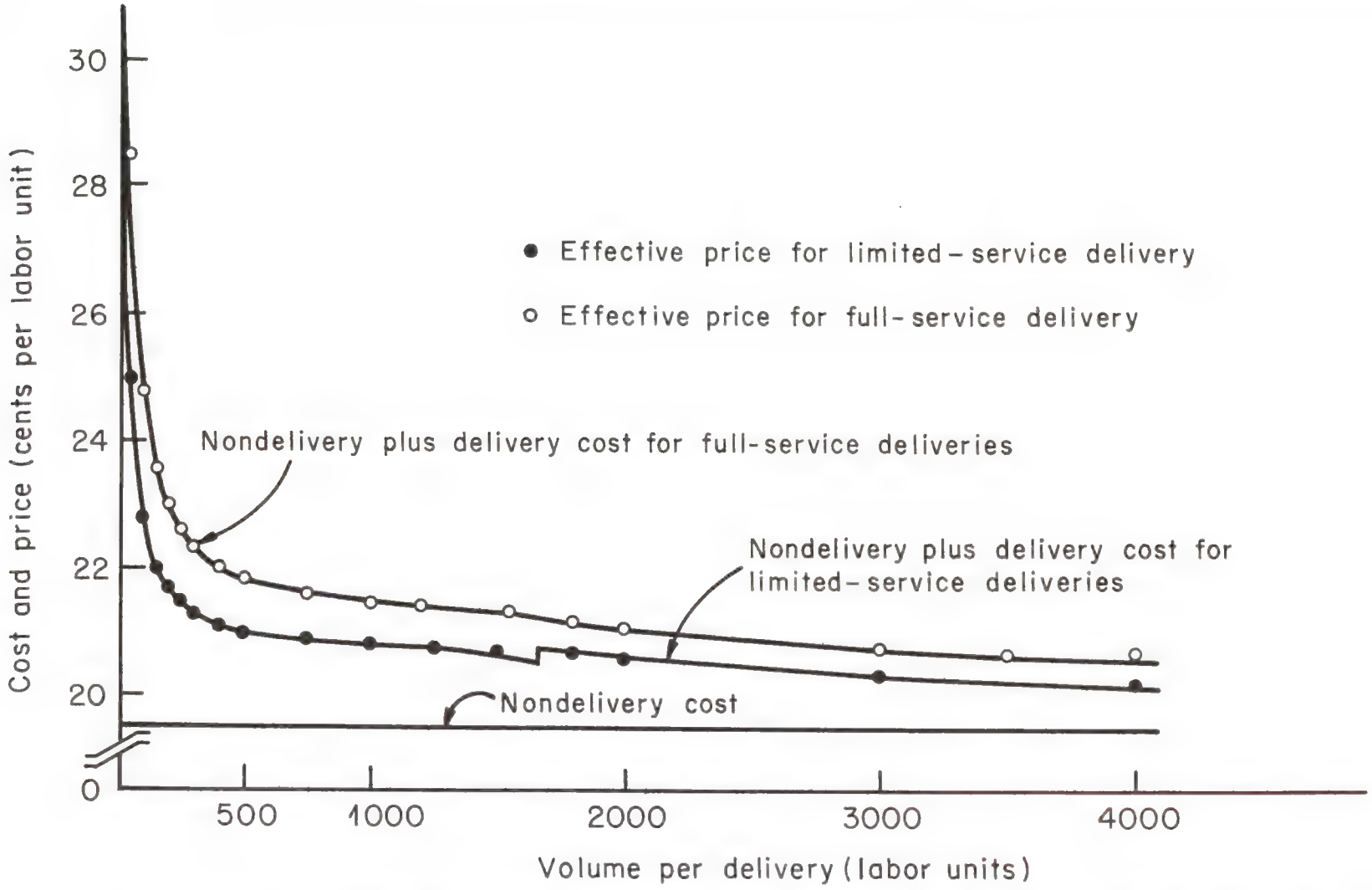


FIGURE 9 Illustration of Service-Charge Pricing Procedure in Reflecting Cost Differentials for Fluid Milk in One-Half Gallon Containers, Wholesale Milk Delivery Routes, Central Coast Counties Marketing Area, 1970-71

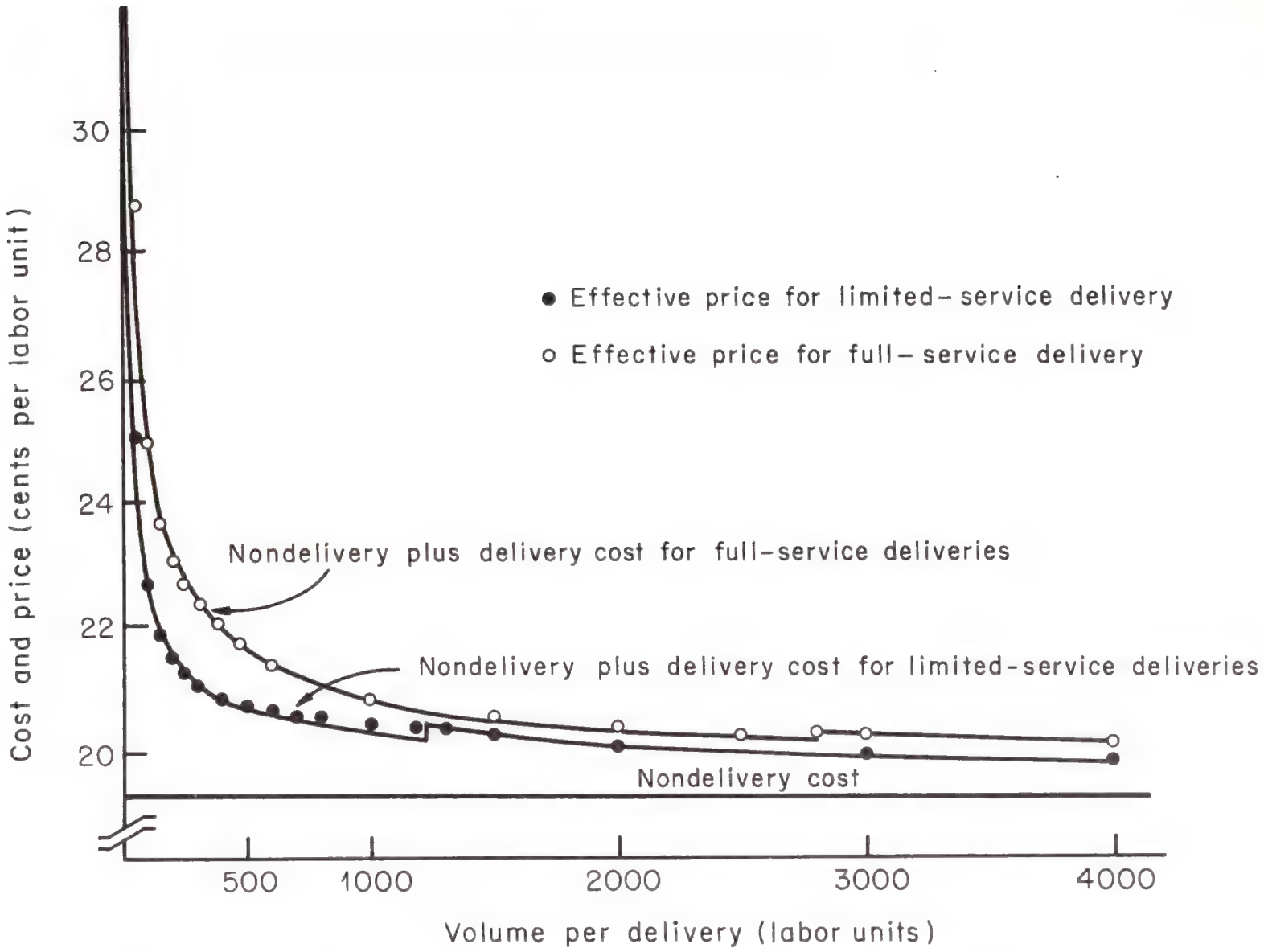


FIGURE 10 Illustration of Service-Charge Pricing Procedure in Reflecting Cost Differentials for Fluid Milk in One-Half Gallon Containers, Wholesale Milk Delivery Routes, Southern Metropolitan Marketing Area, 1970-71

*APPENDIX A*

## *WHOLESALE MILK ROUTE RIDING INSTRUCTIONS*

1. Refer to "Wholesale Time Study Sheet–Time Functions" and fill in the following information:

   a. Marketing area.

   b. Zone.

   c. Plant.

   d. Date.

   e. Route No.

   f. District (section of town, community, city, etc.).

   g. Driver's name (specify whether regular or relief).

   h. Timer (your name).

   i. Type and size of delivery equipment (example: Semitrailer–24 foot; single-unit truck (bobtail)–14 foot, etc.).

   j. Type of unloading equipment on truck.

      (1) Battery-powered cart.

      (2) Hand truck.

      (3) Four-wheel dolly.

      (4) Fork lift.

      (5) Other (specify).

   k. Does truck have a hydraulic lift?

      (1) Answer yes or no.

      (2) If so, at which stops was hydraulic lift used to unload product by moving lift up and down?

2. Set your regular watch with the time clock time at the plant.

3. The STARTING TIME should be recorded as the time when the driver's pay begins. For example, if the driver is required to start work at 6:30, this will be the starting time even though he may have punched in earlier, say at 6:22. On the other hand, if the driver is late for work and his punch-in time is after 6:30, then the punch-in time–which might be 6:36–is the official starting time. To summarize: The STARTING TIME is the time the driver's work shift begins or, in the event he is late for work, the punch-in time.

4. The time at plant before delivery is defined as the difference between the STARTING TIME and the time the truck leaves the distributor's premises. A breakdown on this time should be recorded on the reverse side of a wholesale time study sheet. Shown below are some examples of time functions which might be encountered:

   a. Gassing truck.

   b. Load and check.

   c. Checking load before leaving plant.

   d. Pick up route supplies.

   e. Talking with route supervisor.

   f. Waiting in driver's room.

5. Time will be recorded in minutes and tenths of minutes for all time functions, other than time at plant before delivery and time at plant after delivery, which will be recorded to the nearest minute.

6. Start your stopwatch at the time the truck leaves the distributor's PREMISES and record on the time study sheet the following information:

   a. The time when truck leaves the distributor's plant.

   b. Mileage shown on the truck speedometer at distributor's plant.

7. When the truck arrives at the first stop and comes to a halt, record the following information:

   a. Enter the speedometer mileage in the box provided for "MILEAGE 1ST STOP."

   b. In the "TIME BETWEEN STOPS" column, record the ELAPSED time, expressed in minutes and tenths of minutes, from the plant to the first stop.

   c. Also on this line, record the stop number in the "STOP NO." column. The first stop will be number 1, and each stop will be numbered consecutively.

   d. On the same line that the stop number is shown, list the TYPE OF STOP and NAME OF STOP such as CAFE–LEOPARD, SUPERMARKET–RALPH'S, etc. This information is necessary for identification since some stops may have "call-backs." Also, record the TYPE OF SERVICE as follows:

      (1) Regular or full service.

      (2) Express service.

      (3) Limited service or drop shipment.

      (4) Drop shipment–consumed on premises (C.O.P.).

e. A "call-back" should be considered as a stop, numbered and cross-referenced to the original stop. Call-backs may involve full service or perhaps only picking up empty cases or stocking the milk case.

f. Also, on the same line, answer the following question either YES or NO: Does stop have unloading dock or pit?

g. If the answer to the above question is YES, then answer YES or NO to the following question: If dock or pit was available, was it used?

8. Record in the "NO. OF DIST." column the number of distributors serving this stop. Include the distributor's route you are riding as one of the distributors. A distributor means a milk truck delivering milk or milk by-products. Do not include deliveries from ice cream trucks, butter trucks, or cottage cheese trucks, etc., as a distributor.

9. Delivery.

a. The TOTAL DELIVERY TIME for delivery operation represents the total time devoted to servicing each individual customer. This time will be shown on the same line that the STOP NO. and TYPE OF STOP information is recorded.

b. The BASIC DELIVERY TIME represents the performance of the following basic delivery functions and must be recorded as a separate item:

(1) PUT UP ORDER–Time required to secure the product from the truck and make up the customer's order.

(2) TRANSPORTING ORDER–Time required to take the product from the truck to designated point of delivery such as unloading dock, dispensing box, or storage box.

(3) CUSTOMER CHECKING ORDER–Generally done after delivery, and driver usually has to "wait" for the checker. Any wait time in excess of three minutes will be considered excessive and should be timed and recorded under MISCELLANEOUS AND ABNORMAL TIME as Excessive Waiting (see item 10b of instructions).

(4) OBTAIN CASH OR SIGNATURE–One or the other is the usual normal function with each delivery. This time includes:

(a) Clerk checking "Route Returns" credit slip.

(b) Time spent by driver extending the sales or credit slips.

(c) Time spent with customer while the tag is checked and signed or counting the cash and checking the cash.

(5) COMPLETE DELIVERY–Includes time required to pick up empty cases, if any, return them to the truck, and for the driver to get back into the truck and start truck moving.

c. In addition to the above basic time functions, the following additional services may be performed:

(6) SECURE ORDER–This function consists of the following and will apply to milk and/or by-products:

(a) Walking to premises to obtain order from the time truck comes to a halt.

(b) Checking dispensing box and/or reserve storage box to determine what is needed.

(c) Writing up sales tag (but not extension of prices).

(d) Returning to truck.

(7) SERVICE DISPENSING BOX–This includes:

(a) Arranging or straightening out the box, picking up leakers and old items, and at the same time making up the order.

(b) Also includes all the time in placing and arranging the products delivered in the dispensing box.

(c) Includes any time spent in cleaning up the dispensing box.

(d) Restaurants, cafeterias, and schools, etc. Make no distinction between dispenser box and storage box. List either type service here and not under SERVICE STORAGE BOX.

(8) SERVICE STORAGE BOX–This refers to the reserve box as distinguished from the dispensing box. The reserve box may be the storage section of a walk-in box or a separate walk-in box not connected with the dispensing box.

(9) SERVICE DISPENSING BOX FROM STORAGE BOX–As distinguished from servicing the dispensing box directly from the truck. This may occur on a call-back or may be a portion of the daily service, such as first moving the storage box milk to the dispensing box before making up the day's order.

(10) OTHER–In the event any other delivery service not listed above is performed, please identify the type of function.

The above groupings are all a part of delivery, and individual timing of the components is not necessary except to segregate the TOTAL BASIC DELIVERY TIME from the TOTAL DELIVERY TIME.

10. Time Between Stops and Delivery.

a. Such times may be interrupted by MISCELLANEOUS AND ABNORMAL TIME functions. When these occur, note this time on your REGULAR watch. Then record total elapsed time of this miscellaneous or abnormal function in the designated column.

b. Miscellaneous time would be time taken for coffee breaks, personal time, lunch, inventory of truck away from plant, arranging truck load, excessive wait and talk time (any time over three minutes should be considered excessive). Some or all of these items occur on most routes daily.

c. Abnormal time would cover items which normally do not occur on a wholesale route such as waiting for store to open, truck breakdown, accident, etc. These items should be described and the corresponding time recorded.

11. If more than one customer is served from a particular truck stop, do not show any time in the "Time Between Stops" column, except for the first customer. Walking to the second customer's establishment will be the start of Delivery to this customer, and the completion of Delivery for the second customer will be at the time the driver returns to truck and starts the truck moving.

12. Record the TICKET NO. from the driver's milk tag on the time study sheet to correspond with the applicable stop.

13. Return to plant.

    a. Be sure and know when the driver is at his last stop for the day. At this stop, record the speedometer reading in the LAST STOP mileage box at the top of the page.

    b. Similarly, record the speedometer reading upon the return to plant in the ENDING MILEAGE box at the top of the page.

    c. Also record the time in the TIME RETURN PLANT box at the top of the page when the truck enters the premises of the distributor's plant.

    d. The final time recording will be made in the PUNCH-OUT TIME box at the top of the page when the driver punches out his time card at the end of the day.

14. The time at plant after delivery is defined as the elapsed time between the time when the truck returns to the premises of the distributor's plant and the punch-out time. A breakdown of this time should also be recorded on the reverse side of the Wholesale Time Study Sheet-Time Functions. Shown below are the following examples:

    a. Waiting to unload.

    b. Gassing truck.

    c. Unloading truck.

    d. Returning products to Cold Room.

    e. Parking truck.

    f. Travel time to driver's room.

    g. Making out next day's order.

h. Book work.

i. Turning in milk tags.

j. Turning in cash.

If route is more than an eight-hour day, please indicate on the bottom of the time study sheet whether the driver is paid at regular or overtime rates or is given time off. If any other arrangement, please explain.

15. Form 200-101 (Wholesale Time Study Sheet-Units Delivered).

a. Refer to this sheet and fill in the following information at the top of the sheet:

(1) Name of plant.

(2) Date.

(3) Route number.

(4) Driver.

b. Identify the STOP NO. with the STOP NO. shown on the time study sheet (Form 200-036).

c. Record in the columns headed U (for Unit) the total number of units delivered for each stop, as follows:

(1) BULK units (can or plastic containers) which are combined for all products by type and size of container.

(2) All bulk items should be recorded in number of units rather than gallons.

(3) MILK AND LOW FAT IN FIBER CONTAINERS. Combine all milk items (regular, premium, pasteurized, homogenized, low fat, etc.) by container size. Example: ½-gallon, quart, etc.

(4) CREAM IN FIBER CONTAINERS. This will include whipping cream, pastry cream, and table cream by container size.

(5) FLUID BY-PRODUCTS FIBER will include items listed in footnote on form and, in addition, ICE CREAM MIX and MILK SHAKE MIX by container size shown.

(6) Regular ICE CREAM, IMITATION ICE CREAM, and ICE CREAM NOVELTIES will be shown separately by size and type of container in units at the bottom of the sheet.

(7) FLUID BY-PRODUCTS IN GLASS BOTTLE CONTAINER. This is most likely to be orange juice. If it is milk or low fat milk, it should be shown as a separate item at bottom of sheet by container size and type of container.

(8) The COTTAGE CHEESE classification will also include Sour Cream, Salads, and Puddings. Half-pints should be classified as "Under 1 pound per unit." Pints should be shown under "1 pound per unit." Quarts and half-gallons should be shown under the 1-pound through 5-pound classification. Bulk items exceeding 5 pounds should be listed by type of product in pounds at the bottom of the sheet. Example: Bulk cottage cheese-10 pounds.

(9) YOGURT should be recorded by the size of container shown. All other sizes should be shown at the bottom of the sheet. Example: Yogurt-pints-40 units.

(10) CREAMERS are usually ½ ounce or ¾ ounce and are sold by the box which contains either 100 or 120 units to the box. Record only the number of boxes.

(11) PRESSURE CAN PRODUCTS would include such items as Reddi-Whip, Quip, etc. These items come in pressurized cans of various sizes ranging usually from 6 to 16 ounces. Combine all sizes and show number of units in one figure.

(12) BUTTER AND MARGARINE including OLEO should be converted into total number of pounds for all sizes including bulk.

(13) EGGS regardless of grade, size, or package (case or flat) should be converted to number of dozens.

(14) ALL HARD CHEESE regardless of size should be converted to number of pounds.

(15) The unit classification shown on form No. 200-101 should account for over 98 percent of the items delivered. However, there will occasionally be other miscellaneous items delivered which must be accounted for. These items should be listed and described on the four vacant lines at the bottom of the sheet. Items of this nature might include such items as mayonnaise (record number of units and indicate number of gallons in container). Another item might be bulk powdered milk or powdered skim milk which should be reported by number of pounds.

d. Do not write in the columns designated MU (Modified Unit). These columns will be used by Bureau Personnel at a later date to compute the Modified Labor Units.

16. Make arrangements with driver to provide you with a copy of the milk tag to support the unit data recorded on form No. 200-101. If this is not possible, then try to obtain a blank milk tag and copy the information on this form from the driver's milk tag. In any event, a duplicate record of the units delivered at each stop (identify stop by route number and stop number) must be prepared which will describe the information shown on the milk tag.

CALIFORNIA DEPARTMENT OF AGRICULTURE
BUREAU OF MILK STABILIZATION

WHOLESALE TIME STUDY SHEET--UNITS DELIVERED

PLANT_____ DATE_____ ROUTE NO._____ DRIVER_____

| | LABOR MOD. | STOP U | STOP MU | STOP U | STOP MU | STOP U | STOP MU | STOP U | STOP MU | STOP U | STOP MU | STOP U | STOP MU | STOP U | STOP MU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 Gallon Can | 24.00 | | | | | | | | | | | | | | |
| 5 Gallon Can | 24.00 | | | | | | | | | | | | | | |
| 3 Gallon Can | 12.00 | | | | | | | | | | | | | | |
| 2 Gallon Can | 12.00 | | | | | | | | | | | | | | |
| 6 Gallon Plastic | 24.00 | | | | | | | | | | | | | | |
| 3 Gallon Plastic | 12.00 | | | | | | | | | | | | | | |
| Other Bulk | | | | | | | | | | | | | | | |
| MILK & LOW FAT--FIBRE | | | | | | | | | | | | | | | |
| 1 Gallon | 4.00 | | | | | | | | | | | | | | |
| 1/2 Gallon | 2.00 | | | | | | | | | | | | | | |
| Quart | 1.00 | | | | | | | | | | | | | | |
| Pint | .80 | | | | | | | | | | | | | | |
| 1/3 Quart | .70 | | | | | | | | | | | | | | |
| 1/2 Pint | .60 | | | | | | | | | | | | | | |
| CREAM--FIBRE | | | | | | | | | | | | | | | |
| Quart | 2.00 | | | | | | | | | | | | | | |
| 1/2 Pint | 1.00 | | | | | | | | | | | | | | |
| FLUID BY-PRODUCTS--FIBRE[1/] | | | | | | | | | | | | | | | |
| 1 Gallon | 4.80 | | | | | | | | | | | | | | |
| 1/2 Gallon | 2.40 | | | | | | | | | | | | | | |
| Quart | 1.20 | | | | | | | | | | | | | | |
| Pint | 1.00 | | | | | | | | | | | | | | |
| 1/3 Quart | .90 | | | | | | | | | | | | | | |
| 1/2 Pint | .80 | | | | | | | | | | | | | | |
| FLUID BY-PRODUCTS--GLASS[1/] | | | | | | | | | | | | | | | |
| 1/2 Gallon | 3.60 | | | | | | | | | | | | | | |
| 48 Ounce | 2.70 | | | | | | | | | | | | | | |
| Quart | 1.80 | | | | | | | | | | | | | | |
| Pint | 1.50 | | | | | | | | | | | | | | |
| COTTAGE CHEESE[2/] | | | | | | | | | | | | | | | |
| Under 1 Pound--Unit | 1.00 | | | | | | | | | | | | | | |
| 1 Pound Per Unit | 1.00 | | | | | | | | | | | | | | |
| 1-5 Pounds Per Unit | 2.00 | | | | | | | | | | | | | | |
| YOGURT | | | | | | | | | | | | | | | |
| Quart | 2.00 | | | | | | | | | | | | | | |
| 1/2 Pint | 1.00 | | | | | | | | | | | | | | |
| CREAMER--100/Box-Box | 3.00 | | | | | | | | | | | | | | |
| PRESSURE CAN PRODUCTS | 2.00 | | | | | | | | | | | | | | |
| BUTTER & MARG.-POUNDS | 1.00 | | | | | | | | | | | | | | |
| EGGS--DOZEN | 1.00 | | | | | | | | | | | | | | |
| HARD CHEESE--POUNDS | .60 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| TOTAL LABOR UNITS | | | | | | | | | | | | | | | |

1/ Includes Skim, Half & Half, Chocolate, Buttermilk, Certified Milk, Concentrated Milk, Goat Milk, Low Sodium Milk, Orange Juice, and Fruit Drinks.

2/ Includes Sour Cream, Salads, and Puddings.

CODE: U .....Unit
MU.....Modified Unit

200-101 (10/70)

WHOLESALE TIME STUDY SHEET--TIME FUNCTIONS

MARKETING AREA_____ZONE_____PLANT_____DATE_____ROUTE NO._____DISTRICT_____DRIVER_____TIMER_____

TYPE & SIZE OF DELIVERY EQUIPMENT_____TYPE OF UNLOADING EQUIPMENT ON TRUCK_____DOES TRUCK HAVE A HYDRAULIC LIFT?_____

STARTING TIME_____TIME LEAVE PLANT_____TIME RETURN PLANT____PUNCH OUT TIME____STARTING MILEAGE____MIL. 1ST STOP____MIL. LAST STOP_____ENDING MIL._____

| STOP NO. | TICKET NO. | TYPE OF STOP | TYPE OF SERVICE | DOES STOP HAVE UNLOADING DOCK OR PIT? | IF DOCK OR PIT WAS AVAILABLE WAS IT USED? | NO. OF DIST. | TIME BETWEEN STOPS | BASIC DELIVERY TIME | ADDITIONAL FUNCTIONS PERFORMED | TOTAL DELIVERY TIME | MISCELLANEOUS & ABNORMAL TIME |
|---|---|---|---|---|---|---|---|---|---|---|---|
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AT WHICH STOPS WAS HYDRAULIC LIFT USED TO UNLOAD PRODUCT BY MOVING LIFT UP AND DOWN?_____

200-036(11/70)